MOTION IMAGERY STANDARDS PROFILE

Department of Defense/Intelligence Community/
National System for Geospatial Intelligence
(DoD/IC/NSGI)
Motion Imagery Standards Board

Version 3.0

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PREFACE

This document summarizes the Motion Imagery Standards Profile (MISP), formerly known as the Video Imagery Standards Profile (VISP), work to-date by the Department of Defense/Intelligence Community/National System for Geospatial Intelligence (DoD/IC/NSGI) Motion Imagery Standards Board (MISB), formerly known as the Video Working Group (VWG). MISB Points of Contact include:

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2 INTRODUCTION

2.1 Scope

In accordance with Department Of Defense Directive Number 5105.60 (dated 11 October 1996), which established the National Geospatial-Intelligence Agency (NGA); and whereas: "The NGA shall provide timely, relevant, and accurate imagery, imagery intelligence, and geospatial information in support of the national security objectives of the United States"; and whereas NGA shall: "Prescribe and mandate standards and end-to-end technical architectures related to imagery, imagery intelligence, and geospatial information for the DoD Components and for the non-DoD elements of the Intelligence Community…" to include:

> "Standards for end-to-end architectures related to imagery, imagery intelligence, and geospatial information."
>
> "Technical guidance and direction to all the DoD Components and the non-DoD members of the Intelligence Community regarding standardization and interoperability of systems requiring geospatial information or imagery support", and "for exploitation and dissemination of imagery and imagery intelligence products and geospatial information."

And whereas NGA shall: "Develop policies and provide DoD participation in national and international imagery, imagery intelligence, and geospatial information activities…"

The Motion Imagery Standards Board (MISB) is hereby designated as the organization, under the supervision of the National Center for Geospatial-Intelligence Standards (NCGIS), to formulate, review and recommend standards for motion imagery, associated metadata, audio and other related systems for use within the Department of Defense / Intelligence Community / National System for Geospatial Intelligence (DoD/IC/NSGI). The MISB will formulate and make recommendations to the NCGIS on all proposed motion imagery, associated metadata, audio, and other related systems standards for compliance with the technical goals of the DoD Joint Technical Architecture (JTA) and NSGI Technical Architecture (NTA). The MISB will therefore monitor and participate in changes to, and the implementation of, related motion imagery, metadata, audio and associated systems standards in national and international arenas for impacts to DoD/IC/NSGI Systems.

2.2 Motion Imagery Standards Board Mission

Whereas, motion (video) imagery has been recognized by the DoD/IC/NSGI as a fundamentally important source of imagery intelligence, and whereas; improved battle-space/intelligence-space awareness using motion imagery (video) sensors has been identified as a key developing technology area in policy documents such as DoD Joint Vision 2010; the mission of the MISB is to ensure the development, application and implementation of standards that maintain interoperability and quality for motion imagery, associated metadata, audio and other related systems in the DoD/IC/NSGI. The MISB will monitor and participate in the development of and changes to adopted standards and

assess their impacts on systems and DoD/IC/NSGI architectures through community input and discussion. Additionally, the MISB will participate in the North Atlantic Treaty Organization (NATO) Standards Agreement (STANAG) process for coalition force interoperability and also participate in US and international standards bodies to monitor, advocate, and represent DoD/IC/NSGI interests for motion imagery, associated metadata, audio, and related systems to support global interoperability and protect image and information quality.

This DoD/IC/NSGI Motion Imagery Standards Profile (MISP) is a direct expression of the MISB mission and serves as the master baseline standards document prepared and managed by the MISB. The JTA, NTA, and NATO will reference the MISB as shown in Figure 1–1 yielding seamless international interoperability for coalition force operations.

The following chronology explains the development of versions of the VISP/MISP:

- Version 1.00 was approved as the baseline document by GSMC-ISMC on 12 June 1997.
- VISP Version 1.10 was approved by GSMC-ISMC on 26 September 1997.
- VISP 1.20 was provisionally approved by the VWG on 19 November 1997.
- VISP 1.21, approved by the VWG on 7 January 1998, was the baseline motion imagery standards document for the Joint Technical Architecture (JTA) Version 2.0.
- VISP 1.30, approved by the ISMC on 6 March 1998, was initially proposed as the motion imagery standards baseline document for the JTA 3.0.
- VISP 1.4, approved by the ISMC on 12 August 1999, was the final baseline motion imagery standards document for the JTA, Version 3.0 and the NSGI Technical Architecture, Revision A, 26 January 1999.
- VISP 1.5 was approved by the GSMC-ISMC on 24 February 2000.
- MISP 1.6 is the motion imagery standards baseline document for the JTA 4.0 and the next revision to the NTA.
- MISP 1.7 was approved by the GSMC-ISMC on 1 March 2001.
- MISP 2.0 is the motion imagery standards baseline document for the JTA 6.0 and the ICSIS Horizontal Integration Baseline Document, and the next version of the NSGI.
- MISP 3.0 incorporated Infrared (IR) motion imagery standards.

All DoD/IC/NSGI organizations that use motion imagery technologies are encouraged to participate in MISB activities and represent their specific requirements and issues.

2.3 MISP Document Format

Chapter 1 provides introductory material applicable to the entire MISP document. Chapter 2 documents APPROVED Commercial Standards, Interoperability Profiles, Recommended Practices and Engineering Guidelines for DoD/IC/NSGI implementations. Please note several special cases in Chapter 2 where clearly identified sub-elements of an approved item still remain in STUDY status. Appendix A outlines EMERGING Standards, Profiles, and Recommended Practices (RP) that are still in STUDY Status.

To address the need for balance between simply noting a standard and noting the why and how such a standard should be used, the MISP includes appendices which provide supplemental information users can refer to in order to better understand the underlying technical concepts of this document. Appendix B provides detailed citations and references for standards specified in the MISP. Appendix C identifies acronyms and abbreviations and Appendix D is a record of revisions.

The MISP points to a number of documents as normative references. As shown in Figure 1-1 they fall into the categories of Industry Standards that are the due-process standards followed by commercial vendors and developers; and MISB documents specifically developed for motion imagery applications when there are no industry standards to meet specific DoD/IC/NSGI needs. Documents developed by the MISB include the Core Motion Imagery Metadata (formerly known as Core Video Metadata) definitions used in Unmanned Aerial Vehicle (UAV) analog closed captioning; Image Product Libraries (IPLs): the Metadata Dictionary and Encoding document for placing metadata in digital bit streams; the document on National Imagery Transmission Format (NITF) Wrappers for Motion Imagery being developed for the exchange and archival storage of MPEG-2 files; and the document on Motion Imagery, Security, Authentication, and Encryption being developed for the security/releasability marking of motion imagery and associated metadata.

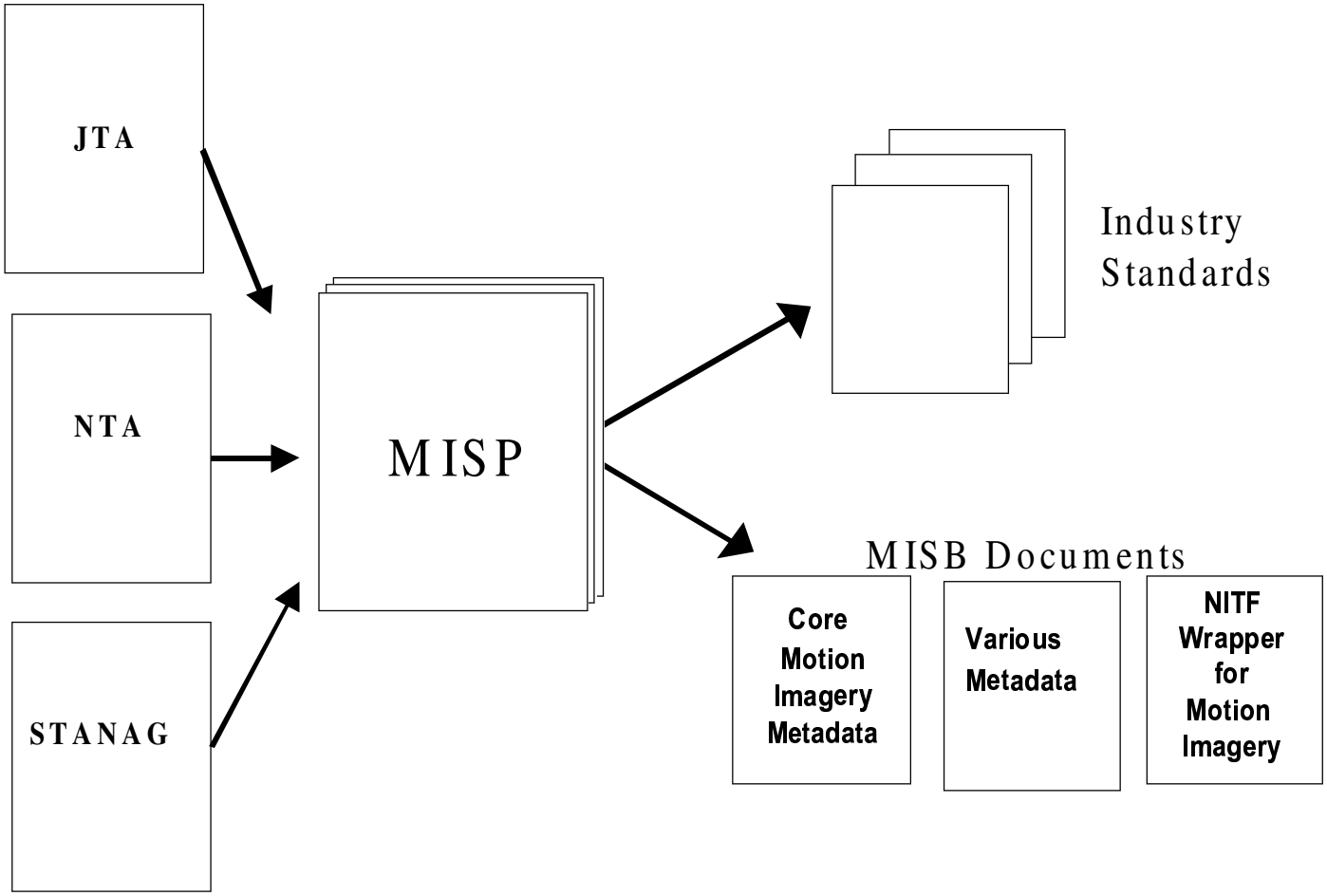

Figure 1-1. Other MISP Referenced Document Categories

2.4 Classes of Motion Imagery and Related Systems

In the broadest context of imagery applications, the major divisions are:

STILL Imagery / MOTION Imagery / SYNTHETIC Imagery

This document addresses applications associated with Motion Imagery.

2.5 Motion Imagery

MOTION Imagery is defined as imaging sensor / systems that generate sequential or continuous streaming images at specified temporal rates (normally expressed as frames per second), ***within a common field of regard***. MOTION Imagery is defined as nominally beginning at frame rates of 1 Hz (1 frame per second) or higher.

Within the major division of MOTION Imagery, the following domains are currently specified:

1) Electro Optical (including Video and Television)
2) Infrared (including low-light television)
3) Multispectral (MSI)/Hyperspectral (HSI)

2.5.1 Electro Optical Domain

Within the Motion Imagery Electro-Optical domain, specific definitions are given for Video and Television sub-domains:

Video is defined as Electro-Optical motion imagery technologies defined by standards developed by the International Organization for Standards (ISO), International Telecommunication Union (ITU), Society of Motion Picture and Television Engineers (SMPTE), European Broadcasters Union (EBU), etc., reviewed, adopted and profiled for DoD/IC/NSGI applications by designated DoD/IC/NSGI standards bodies such as the MISB.

Television is defined as Video formats and implementations defined by Government Transmission Regulations such as NTSC, PAL, SECAM, FCC 4th Report and Order; reviewed, adopted and profiled for DoD/IC/NSGI applications by designated DoD/IC/NSGI standards bodies such as the MISB.

For analog technologies, there has always been a direct coupling of television and video waveforms, production, transmission, and receiver designs. With the advent of digital technologies; production, transmission and receiver systems can be de-coupled. Therefore, the requirements and or limitations of transmission regulations, typically specified for civilian (general public) applications, are not necessarily applicable for DoD/IC/NSGI applications.

2.5.1.1 Motion Imagery Sub-Domains

Motion Imagery systems, defined as electro-optical motion imagery whose formats are governed by national and international standards, are divided into four (4) categories:

1. Motion Imagery Systems (used to create, process, manipulate, exploit, store, archive and disseminate Motion Imagery, nominally video), both for real-time and other end-user wide area product distribution, in support to imaging applications, including (but not limited to) Intelligence, Surveillance, and

Reconnaissance (ISR), Exploitation, and all other motion imagery-based systems not specifically defined below.

2. Video Teleconference Systems provide real-time visual interchange between remote locations typically in support of meetings. When video teleconference systems are used for the display of motion imagery, the standards for motion imagery apply.
3. Video Telemedicine Systems provide real-time visual interchange between remote locations in biomedical applications including fiber optic and video teleconferencing.
4. Video Support Services enable end-user applications associated with motion imagery (video)-based training, newsgathering or other non-critical functions that do not directly support the warfighter. This includes traditional studio and field video productions, which are not associated with DoD warfighter operations.

2.5.2 Infrared

This document presents new standards for infrared systems. The MISB anticipates an intensive effort to add additional standards. When completed, the standards will be promulgated within future versions of the MISP.

2.5.3 Multispectral/Hyperspectral (MSI/HSI)

There are no standards defined for motion imagery MSI or HSI systems in this version of the MISP.

2.6 Motion Imagery Standards Profile Applicability to DoD/IC/NSGI Communities

The MISP is applicable to all DoD/IC/NSGI motion imagery systems that are subject to the DoD Joint Technical Architecture and the NSGI Technical Architecture. All new motion imagery systems are required to be compliant with provisions of the MISP as soon as practical. All analog motion imagery systems are considered to be legacy systems as of 12 June 1997. In accordance with the MISP, all new systems are required to be based on digital motion imagery technology

Note that by reference here, other classes, communities and users of motion imagery systems (Video Teleconference Systems and Video Telemedicine) are specifically excluded from the mandatory requirements of the MISP. However, when any of these other classes of motion imagery systems are used for the purpose of motion imagery data dissemination then the requirements and provisions of the MISP apply.

These and future to-be-defined motion imagery communities are encouraged to review the applicability of the standards given in the MISP and if deemed practical, implement MISP standards and recommended practices to foster broader interoperability across the entire DoD/IC/NSGI/Federal spectrum. These separate communities are specifically invited to join the DoD/IC/NSGI MISB and merge their requirements into the ongoing development of the DoD/IC/NSGI MISP document.

2.7 Definition of Terms

2.7.1 Standards

Where the MISP term STANDARD is used, the MISP item (chosen by specific MISB adoption, and approved by the NCGIS), mandates binding technical implementation policy, and as such, should be identified in Government procurement actions as a mandatory compliance item in order for vendor offerings to be accepted by the Government.

For point of clarification, in commercial practice the majority of identified standards (notably those from SMPTE) are considered to be "voluntary" standards, where equipment manufacturers and users are free to choose to comply or to not comply with the standard. Standards, as represented in this MISP are not considered voluntary for DoD/IC/NSGI users and systems. They are mandatory.

2.7.2 Profiles

Where the MISP term PROFILE is used, the MISP item documents an extension to a STANDARD developed or specified to meet DoD/IC/NSGI unique mission requirements not normally covered by commercial standards. MISP PROFILES (chosen by specific MISB adoption, and approved by the NCGIS) mandate binding technical implementation policy, and as such, should be identified in Government procurement actions as a mandatory compliance item in order for vendor offerings to be accepted by the Government.

2.7.3 Recommended Practices/Engineering Guidelines

Where the MISP term RECOMMENDED PRACTICE is used, the MISP item documents a recommended implementation or practice that further clarifies the implementation of a STANDARD or PROFILE in order to insure interoperability across DoD/IC/NSGI systems. Recommended Practices chosen by specific MISB adoption should be considered to be a technical implementation policy, and as such, may be identified in Government procurement actions as a mandatory compliance item in order for vendor offerings to be accepted by the Government. Engineering Guidelines represent good engineering principals and therefore, should be implemented if at all possible.

2.7.4 Emerging Standards/Studies

Where the MISP term STUDY is used, the MISP identifies a preliminary version of an anticipated and or emerging STANDARD, PROFILE, RECOMMENDED PRACTICE or Engineering Guideline where the primary initial parameters are outlined and understood but additional coordination or engineering analysis is required. Such items will be forwarded to the appropriate MISB sub-group or ad-hoc committees for action item work-off, with TBD completion suspense dates. At the time of formal adoption, the STUDY will become a standard, profile, recommended practice, or engineering guideline using the same MISP identification number. Until formally adopted by the MISB there is no requirement to implement any portion of any STUDY item.

2.7.5 Frame Rate Annotation

The MISP has attempted to use the following consistent scanning format and frame rate annotations throughout all of the specified MISP profiles:

60p	= 60 Frames Per Second (FPS), Progressively Scanned
60p/1.001	= 59.94 FPS (NTSC compatible frame rate), Progressively Scanned

50p	= 50 FPS, Progressively Scanned
30p	= 30 FPS, Progressively Scanned
30p/1.001	= 29.97 FPS (NTSC compatible frame rate), Progressively Scanned
25p	= 25 FPS, Progressively Scanned
24p	= 24 FPS, Progressively Scanned
24p/1.001	= 23.98 FPS (NTSC compatible frame rate), Progressively Scanned
30i	= 30 FPS, Interlace Scanned, yielding 60 fields per second
	Note that many commercial documents use the term 60i to mean 30i
30i/1.001	= 29.97 FPS (NTSC frame rate), Interlace Scanned
	This is the frame rate associated with "television" in the United States
25i	= 25 FPS, Interlace Scanned, yielding 50 fields per second
24i	= 24 FPS, Interlace Scanned, yielding 48 fields per second
24i/1.001	= 23.98 FPS (NTSC compatible frame rate), Interlace Scanned

For Infrared motion imagery, frame rates of 25, 30, 50, and 60 are preferred, but lower and higher frame rates are allowed and tolerance in the system should allow for 1/1.001 of 30 Hz and 1/1.001 of 60 Hz.

2.7.6 Standard, Enhanced, and High Definition

The MISP has attempted to use the following consistent scanning format definitions throughout all of the specified MISP profiles (see Recommended Practice 9720, Motion Imagery System Matrix for detailed technical specifications for each format):

High Definition (HD) is defined as spatial resolution at or greater than 1280x720 pixels, progressively scanned, at temporal rates at or greater than 24 Hz.

Enhanced Definition (ED) is defined as spatial resolution of at least 720x480 pixels, progressively scanned at temporal rates at or greater than 24 Hz.

Standard Definition (SD) is defined as any interlace scanned format at 720x576 or 720x480.

Note: It is DoD/IC/NSGI policy to migrate to all progressive scanning formats as soon as practical. However, it is recognized that 720x480 and 720x576 interlace systems compose the bulk of existing DoD/IC/NSGI motion imagery imaging systems and that such systems will continue to be used until the end of their practical service life. Such existing interlace systems must not be replaced with new interlace systems.

Infrared (IR) motion imagery is defined in a similar manner to that above. The resolution classes of IR are 160x120, 320x240, 640x480 (including 640x512, 720x480, 720x512, and 720x576), 1024x720 (including 1280x720 and 1024x1024), 1920x1080, and 2048x2048 progressively scanned. Interlaced scanning IR systems are to be treated as legacy systems and shall be replaced with progressive systems at the end of their service lives. See Recommended Practice 0401 for details

2.7.7 Bit Depths

Bit depths of 8 bits are common in electro-optical motion imagery although critical viewing suggests that 10 and 12 bits are preferred. Infrared motion imagery typically has higher bit depths such as 12 and 14 bits, which are preferred.

2.8 DoD/IC/NSGI Motion Imagery Migration Objectives

DoD/IC/NSGI user communities have diverse mission requirements and will select diverse motion imagery systems, across a range of capabilities, to meet system performance objectives. This section outlines the desired end-state of DoD/IC/NSGI motion imagery capabilities. Not all users will require a migration to the highest possible spatial and temporal resolution, but all users should be aware of the target end-objectives for motion imagery capabilities for the DoD/IC/NSGI as described below:

1) The fundamental end-objective for DoD/IC/NSGI motion imagery systems is to move to all digital, progressive scan processing, and square pixels; moving to higher spatial, temporal, and spectral resolutions as technology becomes available.

2) Standard definition, analog interlace is considered as the legacy initial state, where such analog interlace systems are formally considered to be obsolete systems within DoD/IC/NSGI, and as such must not be replaced with any new analog systems. Within analog families, component processing (R:G:B, Y:R-Y:B-Y, Y:C) is always preferred over composite processing (such as NTSC or PAL).

3) Standard definition, digital interlace (Rec. 601-5, 4:2:2 component processing), using serial digital interfaces (SDI, SMPTE 259M/291M) is a logical and most economical upgrade from analog interlace systems. However, the cost differential between standard definition digital interlace and enhanced definition digital progressive systems is minimal and decreasing, therefore a migration to enhanced definition is strongly advised.

4) Enhanced definition, digital progressive (720 x 480 x 60p and 720 x 576 x 50p) can be considered to yield (as of 2000) the best combination of improved spatial and temporal resolution capabilities at minimal increased costs as compared to today's broadcast quality digital interlace (Rec. 601-5) systems. However, 480p and 576p systems do not utilize square pixels and there are insufficient horizontal pixels to properly deliver 16:9 aspect ratio imagery. Therefore, enhanced definition may be a suitable objective end-state for imagery systems that have no requirement to move to high definition spatial or temporal resolutions and do not require wider (16:9) aspect ratios.

5) High Definition, progressive scan imagery (SMPTE 296M-2001) is the desired end-state for DoD/IC/NSGI motion imagery systems. 1280 x 720x (50p) 60p is the target HD imaging format for all existing and currently planned motion imagery collection systems that will be fielded in the next five to ten years. 1920 x 1080 x (50p) 60p is anticipated to become the revised end-objective in approximately five years (when the technology becomes more mature). User communities that do not require high temporal resolution may consider use of 1920 x 1080 x 24p/25p/30p systems in special limited applications with controlled environments (such as studio production, training, etc.). The anticipated dynamic geo-political landscape and military battlespace environment envisioned by Joint

Vision 2010 requires a complex trade space of maximal spatial and temporal resolution, thus 1280 x 720 x (50) 60p will remain the objective architecture end-goal.

2.9 General Implementation Notes and Document Philosophy

It is the intent of the MISP to give users a consolidated, clear and concise view of the standards they will need to build and operate motion imagery systems. The MISP includes guidance on uncompressed, compressed, and related motion imagery sampling structures; motion imagery time standards, motion imagery metadata standards, interconnections, and common language descriptions of motion imagery system parameters. All of the technology outlined in the MISP document is based on commercially available (or very near term available) systems and components based on defined open standards.

However, no single commercial motion imagery standard provides all of the guidance necessary to build interoperable systems for use across the diverse missions of DoD/IC/NSGI. Therefore, the MISP is a collection of standards and practices on how component systems based on commercial standards can interconnect and provide interoperable service to DoD/IC/NSGI users. It is useful to consider the MISP to be a specific technology (motion imagery) domain document that defines concepts necessary for building interoperable, end-to-end motion imagery systems that are based on commercial motion imagery technology. One specific example of the need for clearly defined profiles and recommended practices is the case of MPEG-2, where the commercial MPEG-2 standard broadly defines a capability that maximizes flexibility but does not guarantee interoperability. By carefully selecting "nominal" values from the ranges of choices within a standard, standards management groups and users can better shape interoperability for their classes of applications. It is also noted that in order for standards to achieve interoperability objectives, systems procured for DoD/IC/NSGI missions must have certification authorities that warrant that the systems are compliant with applicable standards and that the systems do what the vendors claim they will do.

The technology of the commercial motion imagery industry, portions of which DoD/IC/NSGI users procure and use to meet government missions, is in a significant transition phase from analog to digital. Over many years, organizations such as SMPTE have worked to standardize motion imagery systems to facilitate interoperability for the highest quality production environments. Such standardization has supported the production industry by giving broadcasters and production centers confidence that systems from multiple vendors would work interchangeably within the production environment while also preserving the highest possible quality. Migration to digital motion imagery production technology has followed similar patterns, where SMPTE standards have been in place for several years to facilitate interoperability of the highest quality digital production systems. Unfortunately, open standards have not been defined for very low data rate motion imagery. For such low bandwidth cases, universal interoperability is rightly a significant concern for DoD/IC/NSGI managers. There are proprietary vendor products that claim "standard" status based on market share but such proprietary products do not presently meet DoD/IC/NSGI guidelines for adoption as approved standards.

Therefore, the MISP identifies commercial standards that define interoperability for high image quality environments and systems (such as common control vans, interconnections nodes, and DoD/IC/NSGI command centers), including high bandwidth transmission of uncompressed and lower bandwidth transmission of compressed motion imagery (video)

signals. The MISP also identifies approaches for interoperability between high bandwidth and low bandwidth systems . DoD users that adopt proprietary compression systems for extremely low bandwidth applications are cautioned that such systems are generally not supported by DoD/IC/NSGI and that the interoperability of such systems is not assured.

The Profiles, Recommended Practices and Studies of this document are included to expressly focus DoD/IC/NSGI uses of commercial standards in order to better manage and support mission interoperability. Table 1.1 summarizes the Standards, Interoperability Profiles and Recommended Practices for DoD/IC/NSGI Implementations, and Motion System Recommended Practices forming the basis of this Motion Imagery Standards Profile document. However, Table 1.1 shall not be used in lieu of the detailed descriptions of this document.

Table 1-1 - Summary of MISP Commercial Standards, Interoperability Profiles and Recommended Practices

Item	Formal Standard Tailored by MISP	Common Name of Tailored Standard
2.0 STANDARDS, INTEROPERABILITY PROFILES, RECOMMENDED PRACTICES AND ENGINEERING GUIDELINES FOR DoD/IC/NSGI IMPLEMENTATIONS		
2.1 Motion Imagery Systems		
RP 9720 – Motion imagery System Descriptions		Motion Imagery System Matrix (MISM)
Study 9720a – Advanced High Definition Motion Imagery		MISM – Levels 12-14
RP 9720b – High Definition Motion Imagery		MISM – Levels 9-11
RP 9720c – Enhanced Definition Motion Imagery		MISM – Levels 6-8
RP 9720d – Standard Definition Motion Imagery		MISM – Levels 3-5
RP 9720e – Low Spatial/Temporal Motion Imagery		MISM – Levels 1-2
RP 9720f – Very Low Temporal Motion Imagery		MISM – Level 0
RP 9721 – Motion Imagery Tape Formats		
2.2 Standard Definition Motion Imagery		
9601 – Standard Definition Digital Motion Imagery, Compression Systems	ISO/IEC 13818-1,2,3,4	MPEG-2
9701 – Standard Definition Digital Motion Imagery, Compression Systems	ISO/IEC 13818-1,2,3,4	MPEG-2 MP @ ML
9702 – Standard Definition Digital Motion Imagery Sampling Structure	ITU-R BT.601-5	4:2:2 Component Digital Video
9703 – Digital Motion Imagery, Uncompressed Baseband Signal Transport and Processing	SMPTE 259M – 1997	Serial Digital Interface (SDI)
9704 – Digital Motion Imagery, Compression Conversions	ITU-R BT.601-5 SMPTE 259M – 1997	4:2:2 Component Digital Video Serial Digital Interface (SDI)
9705 – Standard Definition Digital Motion Imagery, Format Conversions	ITU-R BT.601-5 SMPTE 259M – 1997	4:2:2 Component Digital Video Serial Digital Interface (SDI)
9707 – Standard Definition Digital Motion Imagery Tape Recorder, Digital Motion Imagery Server, and Similar Systems Input/Output Protocol	SMPTE 259M – 1997 IEEE 1394	Serial Digital Interface (SDI) HP Serial Bus
9803 - Serial Data Transport Interface	SMPTE 305.2M - 2000	SDTI
9901 – Fiber Optic Interfaces Uncompressed Baseband Signal Transport and Processing	SMPTE 297M – 1997 SMPTE 259M - 1997	Fiber Optic Standard Connector Types
RP 9902 – Authorized Limited Application of DV Format Video	DV Format IEEE 1394	DV Format Video HP Serial Bus
Migration to Digital		
9719 – Analog Video Migration	ANSI/SMPTE 170M – 1999 ITU-R BT.601-5	Analog Video 4:2:2 Component Digital Video
9709 – Use of Closed Captioning for Core Metadata Analog Video Encoding	EIA-608 (Data Services) 47 CFR 15.119 [EIA-708 for HDTV]	Recommended Practice for Line 21
2.3 Enhanced Definition Motion Imagery		
9811 – Progressively Scanned Enhanced Definition Digital Motion Imagery	ITU-R BT.1358 SMPTE 292M – 1998 SMPTE 349M-2001	Progressive Scan EDTV Serial Interface

Item	Formal Standard Tailored by MISP	Common Name of Tailored Standard
2.4 High Definition Motion Imagery		
9710 – High Definition Television Systems (HDTV)	SMPTE 274M – 1998 SMPTE 292M – 1998 SMPTE 296M – 2001 SMPTE 295M - 2001	1920x1080 HDTV and Interface Bit-Serial Interface 1280x720 HDTV and Interface 1920x1080 50 Hz HDTV and Interface
9723 – Compressed High Definition Advanced Television (ATV) and Associated Motion Imagery Systems	ISO/IEC 13818 - 1,2,3,4 ATSC Doc. A/53	MPEG-2 MP @ HL U.S. Advanced Television
9703 – Digital Motion Imagery, Uncompressed Baseband Signal Transport and Processing	SMPTE 292M - 1998	Serial Digital Interface (SDI) Bit-Serial Interface
2.5 Low Spatial/Temporal Motion Imagery		
9706 – Video Image Still Frames	MIL STD 2500B - NITF 2.1	Video Still Specification
2.6 Metadata		
9708 – Embedded Time Reference for Video Systems	SMPTE 12M – 1999 SMPTE 309M – 1999	SMPTE Time Code MJD
9711 – Intelligence Motion Imagery Index, Geospatial Metadata	Core Motion Imagery Metadata Profile	Core Metadata V 1.0, 14 Mar 97
9712 – Intelligence Motion Imagery Index, Content Description Metadata (Dynamic Metadata Dictionary Structure and Contents)	SMPTE 335M - 2001 SMPTE RP210.8- 2004 SMPTE EG 37 - 2001	Metadata Dictionary Structure Metadata Dictionary Contents Dictionary Node Structure
9713 – Data Encoding Using Key-Length-Value (KLV)	SMPTE 336M - 2001	KLV Protocol
9714 – Time Code Embedding	ITU-R BT.601-5 SMPTE 259M –1997 SMPTE 292M – 1998 SMPTE 309M – 1999	D-VITC SMPTE Ancillary Time Code SMPTE Ancillary Time Code MJD
9715 – Time Reference Synchronization		Time Code synchronized to GPS
9716 – Packing KLV Packets into SMPTE 291 Ancillary Data Packets	SMPTE 291M - 1998	SDI Bit-Serial Interface Metadata Encoding
9717 – Packing KLV Packets into MPEG-2 Systems Streams	ISO/IEC 13818-1,2,3,4 ISO/IEC 13818-1:2000/ AMD 1 SMPTE RP 217	MPEG-2 Metadata Encoding
9718 – Packing KLV Packets into AES3 Serial Digital Audio Streams	AES-3 SMPTE 355M -2001	AES-3 Metadata Encoding
RP 0101 – Use of MPEG-2 System Streams in Digital Motion Imagery Systems		
RP 0102 – Security Metadata Universal Set for Digital Motion Imagery		
RP 0103 - Timing Reconciliation Universal Metadata Set for Digital Motion Imagery		
EG 0104 - Basic Predator KLV Metadata		
0107 - Bit and Byte Order for Metadata in Motion Imagery Files and Streams		big-endian
Item	**Formal Standard Tailored by MISP**	**Common Name of Tailored Standard**
2.7 File Formats		
RP 0106 – Advanced Authoring Formats	AAF	AAF
RP 0107 – Material Exchange Format	MXF	MXF

Table 1-1 (Continued)

Item	Formal Standard Tailored by MISP	Common Name of Tailored Standard
A. EMERGING STANDARDS, INTEROPERABILITY PROFILES AND RECOMMENDED PRACTICES FOR DoD/IC/NSGI IMPLEMENTATIONS		
STUDY 9801 – MPEG-4	ISO/IEC 14496	Coding of Audiovisual Objects
STUDY 9802 – MPEG-7	ISO/IEC CD 15938-1	Multimedia content description interface
STUDY 9803 – Serial Data Transport Interface	SMPTE 305.2M-2000	SDTI – Content Package
STUDY 9804 – Colorimetry		
STUDY 9805 – Standard Motion Imagery Test Materials		
STUDY 9808 – Still Imagery Derived from Motion Imagery		
STUDY 9809 – Audio Interchange	SMPTE 259M – 1997 SMPTE 292M - 1998 ISO/IEC 13818 - 3	AES3 Audio AES3 Audio MPEG-2 Audio; Dolby AC-3
STUDY 9810 – Low Bit-Rate Motion Imagery		
STUDY 9903 - MPEG-2 Embedded Subheader	ISO/IEC 13818-1,2 MIL STD 2500B - NITF 2.1	MPEG-2 Video Still Specification
STUDY 9904 - NITF Support for Motion Imagery	ISO/IEC 13818-1,2 MIL STD 2500B - NITF 2.1	MPEG-2 Video Still Specification
STUDY 0002 – MPEG and KLV Interoperability		
STUDY 0003 – Advanced High Definition Television		
STUDY 0004 – Motion Imagery Security, Authentication, and Encryption		
STUDY 0105 - Unmanned Vehicle KLV Metadata		
STUDY 0106 – Advanced File Formats	AAF, MXF	AAF, MXF
STUDY 0108 – Metadata for Scathe View		
STUDY 0109 - Precision Engagement Metadata		
STUDY 0201 - Motion Imagery Intelligence Annotation Standard and Transport		
STUDY 0202 – Transport of H.264 on MPEG-2	ITU-T Rec. H.222, Amd 3, 2004	Xon2
STUDY 0301 - DoD/IC/NSGI Profile of the SMPTE KLV Metadata Dictionary		
STUDY 0302 – 60.000/30.000 Frames Per Second Video		
STUDY 0303 – AAF – MXF Use Guidance		
STUDY 0304 – MPEG-2 Transport Stream Synchronous Metadata		
STUDY 0401 – Common Metadata Descriptor Documents		
STUDY 0402 – Develop Infrared Motion Imagery Standards		

3 STANDARDS, INTEROPERABILITY PROFILES, RECOMMENDED PRACTICES AND ENGINEERING GUIDELINES FOR DoD/IC/NSGI IMPLEMENTATIONS OF ELECTRO-OPTICAL MOTION IMAGERY SYSTEMS

3.1 Motion Imagery Systems

3.1.1 RECOMMENDED PRACTICE 9720 - Motion Imagery System Matrix

A "Motion Imagery Systems (Spatial and Temporal) Matrix" (MISM) shall define a Recommended Practice for the simple identification of broad categories of Motion Imagery Systems. The intent of the MISM is to give user communities an easy to use, common shorthand reference language to describe the fundamental technical capabilities of DoD/IC/NSGI motion imagery systems. The "Motion Imagery Systems Matrix" includes tables of Technical Specifications and related Notes.

Furthermore, the "Motion Imagery System Matrix - Levels" (MISM-L0 – MISM-L14, where MISM-L14 defines the highest spatial and temporal resolution systems) should only be applied to a single processing node of the end-to-end motion imagery chain, with the overall system specification equaling, at best case, the lowest motion imagery system processing node specification.

The MISM (RP 9720, Revision 1) has six general bands:

9720a – Advanced High Definition Motion Imagery (MISM-L12 –MISM-L14)
9720b - High Definition Motion Imagery (MISM-L9 – MISM-L11)
9720c – Enhanced Definition Motion Imagery (MISM-L6 – MISM-L8)
9720d - Standard Definition Motion Imagery (MISM-L3 - MISM-L 5)
9720e - Low Spatial/Temporal Definition Motion Imagery (MISM-L2 and MISM-L1)
9720f – Very Low Temporal Definition Motion Imagery (MISM-L0)

Table 2-1 depicts the general outline of the MISM-L. The following Tables and their accompanying Technical Notes provide detailed technical specifications of the general performance of each MISM-L level. Please note that the technical parameters of each major MISM-L sub-division will be individually evaluated for adoption by the MISB.

MISM-L includes new tabular descriptions of Motion Imagery system attributes, to include: Spatial Definition (Very High, High, Enhanced, Standard, Low, Very Low); Temporal Definition (Very High, Medium to High, Standard, Low, Very Low); Generation Resiliency (High, Medium, Low, Very Low).

RP	MISM-L	Description
9720a	14	
	13	Advanced High Definition Motion Imagery
	12	
9720b	11	
	10	High Definition Motion Imagery
	9	
9720c	8	
	7	Enhanced Definition Motion Imagery
	6	
9720d	5	
	4	Standard Definition Motion Imagery
	3	
9720e	2	Low Spatial/Temporal Definition Motion Imagery
	1	
9720f	0	Low Temporal Definition Motion Imagery

Table 2-1. Motion Imagery System (Spatial and Temporal) Matrix-Levels (MISM-L)

(VWG, 10 July 1997 - Adopted) (ISMC, 26 September 1997 - Approved) (VWG, 8 June 1999, Language Revised and Recommended to GSMC-ISMC for Approval) (GSMC-ISMC, 12 August 1999 – Approved)(27 July 2000 –Editorial Changes)

3.1.2 STUDY 9720a - MISM, Advanced High Definition Motion Imagery

System Level	Common Description / Intended Application	System Attributes: Spatial Definition	System Attributes: Temporal Definition	System Attributes: Generation Resiliency	Applicable Standard (Note: Other Profiles, Practices may apply)	Nominal Horiz. Res.	Nominal Vert. Res.	Nominal Bit Depth	Frame Rates	Nominal Compression Ratio	Nominal Data Rate	Data Rate Range	Candidate Transport Channels (Nominal Rates)
MISM-L14	Advanced High Definition (AHD) /	Very High	Very High	High	TBD	≥ 1920	≥ 1080p	8 or 10 or 12	50 – 120 FPS	Zero	3 Gb/s	TBD	OC-96-192
MISM-L13	Advanced HD / Processing / Archiving	Very High	Very High	Medium	TBD	≥ 1920	≥ 1080p	8 or 10	50 – 120 FPS	TBD	TBD	TBD	TBD
MISM-L12	Advanced HD / Distribution	Very High	Very High	Low	TBD	≥ 1920	≥ 1080p	8	50 – 120 FPS	TBD	TBD	TBD	TBD

Table 2-2. Advanced High Definition Motion Imagery (Study 9720a)

STUDY 9720a - MISM, Advanced High Definition Motion Imagery, Technical Notes

MISM-L14 Motion Imagery System Matrix-Level 14 (MISM-L14), Uncompressed Advanced High Definition Motion Imagery, is defined as including the following specific acquisition formats:

1920 x 1080, frame rates 60p, 50p; 16:9 Aspect Ratio;

MISL14 Note 1: Only PROGRESSIVE SCAN formats are authorized for advanced high definition DoD/IC/NSGI Motion Imagery acquisition applications (systems used to originate, acquire, produce, process, manipulate, exploit, store, archive and disseminate motion imagery in support to imaging applications, including (but not limited to) Intelligence, Reconnaissance, and Surveillance).

MISM-L13 Motion Imagery System Matrix Level 13 (MISM-L13), Mezzanine Compression Advanced High Definition Motion Imagery is defined as any HD format of MISM-L14 using mild compression. MISM-L13 is intended to describe Advanced HD signals that use mild compression to process and transport Advanced HD signals.

MISM-L12 Motion Imagery System Matrix-Level 12 (MISM-L12) is defined as any HD format of MISM-L14/13 that is highly compressed to use end-user (final link) transport delivery.

(Recommend for Study 8 June 1999) (27 July 2000 – Editorially Revised)

3.1.3 RECOMMENDED PRACTICE 9720b - MISM, High Definition Motion Imagery

System Level	Common Description / Intended Application	System Attributes: Spatial Definition	System Attributes: Temporal Definition	System Attributes: Generation Resiliency	Applicable Standard (Note: Other Profiles, Practices may apply)	Nominal Horiz. Res.	Nominal Vert. Res.	Nominal Bit Depth	Frame Rates	Nominal Compression Ratio	Nominal Data Rate	Data Rate Range	Candidate Transport Channels (Nominal Rates)
MISM-L11	High Definition (HDTV) / Acquisition	High	Medium -High	High	SMPTE 296M-2001, Progressive modes of SMPTE 274M, 295M	1280-1920	720p - 1080p	8 or 10	24 - 60FPS	Zero	1.485 Gb/s	0.36 Gb/s - 2.4 Gb/s	SMPTE 292M, OC-48
MISM-L10	HDTV / Processing / Archiving	High	Medium -High	Medium	SMPTE 296M-2001, Progressive modes of SMPTE 274M, 295M MPEG-2 MP@HL	1280-1920	720p - 1080p	8 or 10	24 - 60FPS	10:1	80 Mb/s	34 Mb/s - 100 Mb/s	SDI, E3, T3, OC-12
MISM-L9	HDTV / Distribution	High	Medium -High	Low	SMPTE 296M-2001, Progressive modes of SMPTE 274M, 295M MPEG-2 MP@HL	1280-1920	720p - 1080p	8	24 - 60FPS	45:1	19.4 Mb/s	10 Mb/s - 44.7 Mb/s	TCDL, Half to Full T3, ATM

Table 2-3. High Definition Motion Imagery (Recommended Practice 9720b)

RECOMMENDED PRACTICE 9720b - MISM, High Definition Motion Imagery, Technical Notes

MISM-L11 Motion Imagery System Matrix-Level 11 (MISM-L11), Uncompressed High Definition Motion Imagery, is defined as including the following specific acquisition formats:

1920 x 1080, frame rates 30p, 25p, 24p; 16:9 Aspect Ratio;
1280 x 720, frame rates 60p, 50p, 30p, 25p, 24p; 16:9 Aspect Ratio

MISM-L11 Note 1: Only PROGRESSIVE SCAN formats are authorized for high definition DoD/IC/NSGI Motion Imagery acquisition applications (systems used to originate, acquire, produce, process, manipulate, exploit, store, archive and disseminate motion imagery in support to imaging applications, including (but not limited to) Intelligence, Reconnaissance, and Surveillance).

MISM-L11 Note 2: 1920x1080x30i (60 field per second interlace) or 1920x1080x25i (50 field per second interlace) systems are not recommended but may be considered for end-user display systems in non-critical applications.

MISM-L10 Motion Imagery System Matrix-Level 10 (MISM-L10), Mezzanine Compression High Definition Motion Imagery is defined as any HD format of MISM-L11 using mild compression. MISM-L10 is intended to describe HD signals that use mild compression to transport and process HD signals using, for example, SMPTE 259M bit-serial interfaces (SDI). Therefore, all MISM-L10 primary routing and distribution hardware systems must comply with SMPTE 259M Level D (360 Mb/s) implementations.

MISM-L9 Motion Imagery System Matrix-Level 9 (MISM-L9) is defined as any HD format of MISM-L11/10 that is highly compressed to use end-user (final link) transport delivery, such as the ATV transport delivery system in the US. MISM-L9 may also include other transport layer delivery systems used by US Treaty partners.

(VWG, 25 February 1998 - Approved As Amended) (ISMC, 6 March 1998 - Approved) (VWG, 8 June 1999, Language Revised and Recommended to GSMC-ISMC for Approval) (GSMC-ISMC, 12 August 1999 – Approved) (MISB, 27 July 2000 – MISB Standard Recommended and Editorially Revised) (20 November 2003 – MISB approved)

3.1.4 RECOMMENDED PRACTICE 9720c - MISM, Enhanced Definition Motion Imagery

System Level	Common Description / Intended Application	System Attributes: Spatial Definition	System Attributes: Temporal Definition	System Attributes: Generation Resiliency	Applicable Standard (Note: Other Profiles, Practices may apply)	Nominal Horiz. Res.	Nominal Vert. Res.	Nominal Bit Depth	Frame Rates	Nominal Compression Ratio	Nominal Data Rate	Data Rate Range	Candidate Transport Channels (Nominal Rates)
MISM-L8	Enhanced Definition (ED) / Acquisition	Enhanced	Medium - High	High	ITU-R BT.1358, SMPTE 294M-2001	640 – 960	480p - 576p	8 or 10	24 – 60 FPS	Zero	360 Mb/s	135 Mb/s - 540 Mb/s	SDI, OC-12
MISM-L7	ED / Processing / Archiving	Enhanced	Medium-High	Medium	ITU-R BT.1358, SMPTE 294M-2001 MPEG-2 MP@HL	640 – 960	480p - 576p	8	24 - 60 FPS	10:1	25 Mb/s	10 Mb/s -50 Mb/s	T3, ATM
					ITU-R BT.1358, SMPTE 294M-2001 H.264 MP@L3 (L3.1 > 30 FPS)	640 – 960	480p - 576p	8	24 - 60 FPS	20 :1	12 Mb/s	5 Mb/s – 14 Mb/s	T3, ATM
MISM-L6	ED/ Distribution	Enhanced	Medium -High	Low	ITU-R BT.1358, SMPTE 294M-2001 MPEG-2 MP@HL	640 – 960	480p - 576p	8	24 – 60 FPS	45:1	5.5 Mb/s	3 Mb/s - 15 Mb/s	GBS, ATM
					ITU-R BT.1358, SMPTE 294M-2001 H.264 MP@L3 (L3.1 > 30 FPS)	640 – 960	480p - 576p	8	24 – 60 FPS	80 :1	3 Mb/s	2 Mb/s – 8 Mb/s	GBS, ATM

Table 2-4. Enhanced Definition Motion Imagery (Recommended Practice 9720c)

RECOMMENDED PRACTICE 9720c - MISM, Enhanced Definition Motion Imagery, Technical Notes

MISM-L8 Motion Imagery System Matrix-Level 8 (MISM-L8), Uncompressed Enhanced Definition Motion Imagery, is defined as digital progressive 480-line and 576-line acquisition formats at 24 to 60 frames per second.

MISM-L8 Note 1: MISM-L8 can be considered to yield a good combination of improved spatial and temporal resolution capabilities at minimal increased costs as compared to today's broadcast quality digital interlace (Rec. 601-5) systems. However, 720x480p and 720x576p systems do not utilize square pixels and there are insufficient horizontal pixels to properly deliver 16:9 aspect ratio imagery.

MISM-L7 Motion Imagery System Matrix-Level 7 (MISM-L7), Mezzanine Compression Enhanced Definition Motion Imagery is defined as any ED format of MISM-L8 using mild compression. Note that a higher compression rate can be used for H.264 versus MPEG-2. H.264 L3.0 can be used for frame rates up to 30 Hz. H.264 L3.1 must be used for frame rates above 30 Hz.

MISM-L6 Motion Imagery System Matrix-Level 6 (MISM-L6) is defined as any ED format of MISM-L8/7 that is highly compressed to use end-user (final link) transport delivery systems. MISM-L6 includes transport delivery systems used by US Treaty partners. . Note that a higher compression rate can be used for H.264 versus MPEG-2. H.264 L3.0 can be used for frame rates up to 30 Hz. H.264 L3.1 must be used for frame rates above 30 Hz.

MISM-L6 Note 1: MISM-L6 has the advantages of progressive scan, bandwidth efficiency, higher vertical resolution and lack of interlace artifacts as compared to standard definition television (MISM-L3 – MISM-L5).

(VWG, 25 February 1998 - Approved As Amended) (ISMC, 6 March 1998 - Approved) (VWG, 8 June 1999, Language Revised and Recommended to GSMC-ISMC for Approval) (GSMC-ISMC, 12 August 1999 – Approved) (27 July 2000 – Editorially Revised) (20 November 2003 – MISB approved) (8 April 2004, MISB approved)

3.1.5 RECOMMENDED PRACTICE 9720d - MISM, Standard Definition Motion Imagery

System Level	Common Description / Intended Application	System Attributes: Spatial Definition	System Attributes: Temporal Definition	System Attributes: Generation Resiliency	Applicable Standard (Note: Other Profiles, Practices may apply)	Nominal Horiz. Res.	Nominal Vert. Res.	Nominal Bit Depth	Frame Rates	Nominal Compression Ratio	Nominal Data Rate	Data Rate Range	Candidate Transport Channels (Nominal Rates)
MISM-L5	Standard Definition (SD) / Acquisition	Standard	Standard	High	SMPTE 259M (4:2:2)	720	480i – 576i	8 - 10	24 – 60 FPS	Zero to 2.5:1	270 Mb/s	270 Mb/s - 360 Mb/s	SDI, OC-12
MISM-L4	SD / Processing / Archiving	Standard	Standard	Medium	MPEG-2 MP@ML	720	480i – 576i	8	24 - 30 FPS	5.5:1 –10:1	15 Mb/s	15 Mb/s	Half to Full T3, TCDL, ATM
					H.264 MP@L3	720	480i – 576i	8	24 - 30 FPS	5.5 – 20:1	10 Mb/s	10 Mb/s	Half to Full T3, TCDL, ATM
MISM-L3	SD / Distribution	Standard	Standard	Low	MPEG-2 MP@ML	720	480i – 576i	8	24 – 30 FPS	28:1	6 Mb/s	3 - 10 Mb/s	GBS, T2, ATM, DVD
					H.264MP@L3	720	480i – 576i	8	24 - 30 FPS	56:1	3 Mb/s	1.5 - 5 Mb/s	GBS, T2, ATM, DVD

Table 2-5. Standard Definition Motion Imagery (Recommended Practice 9720d)

RECOMMENDED PRACTICE 9720d - MISM, Standard Definition Motion Imagery, Technical Notes

MISM-L5 Motion Imagery System Matrix-Level 5 (MISM-L5), Uncompressed Standard Definition Motion Imagery, is defined as uncompressed, 4:2:2 digital interlace motion imagery, including 720 x 480 (to 576) x 24-60 or ITU-R BT.601-5 (4:2:2) Component Video. Note that while both 10 bit and 8 bit implementations are allowed under MISL5, 10 bit implementations are preferred. Note that storage systems (such as some digital motion imagery tape formats) that use bit-serial interface 4:2:2 input/output protocols but use 2.5:1 (near lossless) internal compression will be considered as meeting MISM-L5. Furthermore, all primary routing and distribution hardware systems must comply with SMPTE 259M Level C and D (270/360 Mb/s) implementations to meet MISM-L5. Users are cautioned that true uncompressed processing may be required for the most demanding MISM-L5 applications.

MISM-L4 Digital MPEG-2 compressed motion imagery, with no more than 10:1 compression and H.264 with no more than 20:1 compression defines L-4. Note that 10:1 compression ratio compliant MPEG-2 Main Profile @ Main Level based systems meet MISM-L4 as well as 20:1 compression ratio compliant H.264..

MISM-L3 Digital 4:2:0, MPEG-2 compressed motion imagery, with no more than 28:1 compression and H.264 with no more than 56:1 compression. Note that both these systems are anticipated to meet MISM-L3.

(VWG, 10 July 1997 - Adopted) (ISMC, 26 September 1997 - Approved)(VWG, 19 Nov 1997, Approved as Amended) (VWG, 25 February 1998 - Approved As Amended) (ISMC, 6 March 1998 - Approved) (VWG, 8 June 1999, Language Revised and Recommended to GSMC-ISMC for Approval) (GSMC-ISMC, 12 August 1999 – Approved) (27 July 2000 – Editorially Revised)(12 June 2003 – Editorial to reflect MP@ML) (8 April 2004, MISB approved)

3.1.6 RECOMMENDED PRACTICE 9720e - MISM, Low Bandwidth Motion Imagery

System Level	Common Description / Intended Application	System Attributes: Spatial Definition	System Attributes: Temporal Definition	System Attributes: Generation Resiliency	Applicable Standard (Note: Other Profiles, Practices may apply)	Nominal Horiz. Res.	Nominal Vert. Res.	Nominal Bit Depth	Frame Rates	Nominal Compression Ratio	Nominal Data Rate	Data Rate Range	Candidate Transport Channels (Nominal Rates)
MISM-L2	Low – Medium Distribution	Low - Medium	Low - Medium	Very Low	H.264 MP@L3	352 - 720	240 – 576 progressive preferred	8	24 - 30 FPS	28:1 –56:1	1.5 Mb/s	768 – 1,500 kb/s	T1/ E1
					MPEG-2 MP@ML or MPEG-1	352	240 - 576	8	24 – 30 FPS	28:1	1.5 Mb/s	1 – 1.5 Mb/s	T1/E1
MISM-L1 (Study only)	Very Low – Medium Distribution	Very Low -Medium	Very Low - Medium	Very Low	H.264	176 - 720	120p – 576p	8	24– 30 FPS	56:1	512 Kb/s	32 – 768 Kb/s	Partial T1, Wireless

Table 2-6. Low Bandwidth Motion Imagery (Recommended Practice 9720e)

RECOMMENDED PRACTICE 9720e - MISM, Low Bandwidth Motion Imagery, Technical Notes

- MISM-L2 H.264 MP@L3, Digital MPEG-2 (4:2:0, using Adaptive Field Frame techniques) or MPEG-1 compressed video, using SIF image resolution decimation at 25-30 FPS temporal rate can be used for MISM-L2. It is anticipated that H.264 will provide image quality equal to MPEG-2 at less than half the data rate. Therefore, the preferred method is H.264, which will yield higher quality motion imagery at these data rates. However, early in the development cycle H.264 will be difficult to obtain. H.264 encoders, especially real time encoders will not proliferate until encoding chips are available. The availability of H.264 encoders will principally determine the use of H.264 over MPEG-2.

(VWG, 10 July 1997 - Adopted) (ISMC, 26 September 1997 - Approved)(VWG, 19 Nov 1997, Approved as Amended) (VWG, 25 February 1998 - Approved As Amended) (ISMC, 6 March 1998 - Approved) (27 July 2000 – Editorially Revised)(21 November 2002- Added TBD (H.264)) (12June 2003 – Removed TBD form H.264 and listed it first)(20 November 2003 – MISB approved)

- MISM-L1 H.264 is expected to meet the requirements for MISM-L1. Digital MPEG-2 (4:2:0, using Adaptive Field Frame techniques) and MPEG-1 at SIF resolutions are not usable at these data rates. H.264 can be used be used at data rates below 768 kb/s and the resolution need only be reduced at very low data rates.

(VWG, 26 March 1997 - Approved for Study) (27 July 2000 – Editorially Revised) (21 November 2002- Added H.264) (12 June 2003 –H.264 adopted)(20 November 2003 – MISB approved)

3.1.7 RECOMMENDED PRACTICE 9720f - MISM, Very Low Temporal Definition Motion Imagery

System Level	Common Description / Intended Application	System Attributes: Spatial Definition	System Attributes: Temporal Definition	System Attributes: Generation Resiliency	Applicable Standard (Note: Other Profiles, Practices may apply)	Nominal Horiz. Res.	Nominal Vert. Res.	Nominal Bit Depth	Frame Rates	Nominal Compression Ratio	Nominal Data Rate	Data Rate Range	Candidate Transport Channels (Nominal Rates)
MISM-L0	Very Low Temporal Motion Imagery / Distribution	High	Very Low	Variable	NITF	720 -1920	480 - 1080	8 or 10 or12	Still - 2 FPS	10:1	256 Kb/s	56 – 512 Kb/s	Non Real Time POTS, ISDN

Table 2-7. Very Low Temporal Motion Imagery (Recommended Practice 9720f)

RECOMMENDED PRACTICE 9720f - MISM, Very Low Temporal Definition Motion Imagery, Technical Notes

MISM-L0 Low frame rate motion imagery based on digital video sources using full MISM-L11/8/5 spatial resolution but having very limited temporal resolution (on the order of stills to 1 or 2 FPS). At these low temporal rates, the imagery is no longer considered to be video (thus the motion imagery nomenclature). MISM-L0 is intended to describe applications where the most severe bandwidth limitations preclude delivery of true motion video. For these very low bandwidth applications, systems should deliver full spatial resolution but may need to severely decimate temporal elements to the point of producing only still frames (and delivering such frames in non-real-time, based on the data rate capacity of the delivery channel). For the specific cases of still imagery derived from video sources, such imagery shall be formatted to conform to NITF standards (see PROFILE 9706 - Video Image Still Frames).

(VWG, 26 March 1997 - Approved for Study) (VWG, 25 February 1998 - Approved As Amended) (ISMC, 6 March 1998 – Approved) (27 July 2000 – Editorially Revised)

3.1.8 RECOMMENDED PRACTICE 9721 - Motion Imagery Tape Formats

In reference to Recommended Practice 9720, "Motion Imagery Systems Matrix", the Motion Imagery System Practices for DoD/IC/NSGI motion imagery tape formats shall be as follows:

Tape MISM- Level 11, MISM- Level 8

There are no specific recommendations for uncompressed MISM-L11 or MISM-L8 motion imagery tape implementations as of this version of the Motion Imagery Standards Profile. However, any digital tape format converted into a "bit-bucket" mode with sufficient data bandwidth to store MISM-L11or MISM-L8 signals may be used provided they also:

a) Transparently transport a minimum of two stereo AES3 audio channels,
b) Transparently transport Digital Vertical Interval Time Code (D-VITC) (Longitudinal Time Code (LTC) internal processing/storage is authorized provided D-VITC input and output is maintained.),
c) For MISM-L8, transparently transport a minimum of an additional 6 Mb/s of ancillary data (either as part of the bit-serial interface Ancillary data stream or as additional AES3 audio streams).

(VWG, 26 March 1997 - Approved for Study) (VWG, 25 February 1998 - Language Revised) (VWG, 8 June 1999, Language Revised) (27 July 2000 – Editorially Revised)

Tape MISM- Level 10, MISM- Level 7

Whereas the HD-D5 format has become SMPTE Standard 342, SMPTE 342M-2000 (360 Mbps data rate, using mezzanine compression of authorized DoD/IC/NSGI high and enhanced definition formats such as 1280x720x60p and 720x480x60p) is an authorized initial motion imagery tape implementation partially meeting MISM-L10, MISM-L7 requirements. Other desired MISM-L10 and MISM-L7 attributes include the ability to:

a) Transparently transport a minimum of two stereo AES3 audio channels,
b) Transparently transport D-VITC (LTC internal processing/storage is authorized provided D-VITC input and output is maintained),
c) Transparently transport a minimum of an additional 6 Mb/s of ancillary data (either as part of the bit-serial interface Ancillary data stream or as additional AES3 audio streams).

(VWG, 26 March 1997 - Approved for Study) (VWG, 25 February 1998 - Language Revised) (VWG, 8 June 1999, Language Revised) (27 July 2000 – Editorially Revised)(21 November 2002- Added SMPTE 342M))

Tape MISM- Level 9, MISM- Level 6

The MISB expects that there will be a number of inexpensive tape systems for handling MISM-L9 and MISM-L6 including D-VHS.

(VWG, 26 March 1997 - Approved for Study) (VWG, 25 February 1998 - Language Revised) (VWG, 8 June 1999, Language Revised) (27 July 2000 – Editorially Revised)

Tape MISM-Level 5

For MISM-L5 implementations authorized motion imagery tape formats may include widely accepted commercial systems that:

a) Use 4:2:2 digital processing,
b) Use no compression or use no more than 2.5:1 compression,
c) Use bit-serial interface input/output protocols,
d) Transparently transport a minimum of two stereo AES3 audio channels,
e) Transparently transport D-VITC (LTC internal processing/storage is authorized provided D-VITC input and output is maintained),
f) Transparently transport a minimum of an additional 6 Mb/s of ancillary data (either as part of the bit-serial interface Ancillary data stream or as additional AES3 audio streams).

Anticipated MISM-L5 compliant (subject to verification) tape formats may include:

SMPTE D1 videotape format
SMPTE D5 videotape format
Ampex DCT videotape format
Sony Digital Betacam tape format

(VWG, 26 March 1997 - Approved for Study) (VWG, 25 February 1998 - Language Revised) (VWG, 8 June 1999, Language Revised) (27 July 2000 – Editorially Revised)

Tape MISM- Level 4

For MISM-L4 implementations, authorized motion imagery tape formats may include widely accepted commercial systems that:

a) Use 4:2:2 digital processing,
b) Have no more than 5:1 compression,
c) Use bit-serial interface input/output protocols,
d) Transparently transport a minimum of two stereo AES3 audio channels,
e) Transparently transport D-VITC (LTC internal processing is authorized provided D-VITC input and output is maintained),
f) Transparently transport a minimum of an additional 3 Mb/s of ancillary data (either as part of the bit-serial interface data stream or as additional AES3 audio

Anticipated MISM-L4 compliant (subject to verification) tape formats may include:

Any MISM-L5 videotape format
SMPTE D9 (JVC Digital-S) videotape format
Sony Beta-SX videotape format
SMPTE D7 (DVC Pro 4:2:2) videotape format

(VWG, 26 March 1997 - Approved for Study) (VWG, 25 February 1998 - Language Revised) (VWG, 8 June 1999, Language Revised) (27 July 2000 – Editorially Revised)

MISM- Level 3- MISM- Level 0

For all other Motion Imagery System implementations (MISM-L3-MISM-L0), it is anticipated that information technology based storage systems will be used instead of videotape except for archival purposes. If videotape is used, digital motion imagery tape formats other than MISM-L4 (or higher) may only be used in order to meet specific mission constraints (size, weight, power consumption) that cannot be met with MISM-L4 (or higher) tape formats. In such instances, other such formats may only be used in limited roles such as first generation acquisition, with a requirement to immediately transfer and interface such acquisition formats using SMPTE bit-serial interfaces (with MISM-L4 or higher tape systems) at the first processing interface. See Recommended Practice 9902 for further details.

Anticipated "acquisition-only" tape formats, in order of priority of choice are:

a) Any MISM-L5 motion imagery tape format
b) Any MISM-L4 motion imagery tape format
b) 4:1:1 Digital tape formats
c) Component Analog formats (Y,R-Y,B-Y), such as Betacam-SP or MII
d) High Resolution Analog formats (Y/C), such as Hi8mm or SVHS

(VWG, 26 March 1997 - Approved for Study) (VWG, 25 February 1998 - Language Revised) (VWG, 8 June 1999, Language Revised) (27 July 2000 – Editorially Revised)

Other Video Tape Notes:

"Analog - composite - limited resolution - color under" videotape formats (such as VHS or U-Matic) are not authorized for acquisition, processing or new archive implementations. "Analog - composite - limited resolution - color under" video tape formats may be authorized as the means for video tape mass distribution of finished intelligence products, provided no other digital distribution tape format is widely available. In no case are such formats authorized for new permanent motion imagery archive storage. Existing, legacy archive systems based on "analog - composite - limited resolution - color under" tape formats should convert to one of the new, approved digital tape formats as soon as practical.

Digital composite formats (such as D2, D3) are generally not authorized for any new DoD/IC/NSGI implementations because of their incompatibility with 4:2:2 component processing systems.

No motion imagery tape formats other than MISM-L5 or higher may be used for any new permanent motion imagery tape archives, where MISM-L5 or higher systems should be used for the most demanding applications.

(VWG, 26 March 1997 - Approved for Study) (VWG, 25 February 1998 - Language Revised) (27 July 2000 – Editorially Revised)

3.2 Standard Definition Motion Imagery

3.2.1 STANDARD 9601 – Standard Definition Digital Motion Imagery, Compression Systems

MPEG-2 is the approved motion imagery compression format for DoD/IC/NSGI systems (the VWG and ISMC formally adopted this standard in 1996).

3.2.2 STANDARD 9701 – Standard Definition Digital Motion Imagery, Compression Systems

The 1996 VWG adoption of MPEG-2 (item 9601 above) as the approved motion imagery compression format is hereby superseded by a more detailed specification:

ISO/IEC 13818 - 1,2,3,4 (commonly known as MPEG-2) shall be the DoD/IC/NSGI STANDARD for all standard definition compressed motion imagery, with the following PROFILE specifications:

> The "MPEG-2, Main Profile @ Main Level" (MP @ ML) shall be the standard definition motion imagery compression PROFILE for DoD/IC/NSGI origination, acquisition, production, manipulation, exploitation, and end-user motion imagery product distribution, including real-time wide area transmissions.

ITU-T Rec. H.264 (Baseline, Main, and Extended Profiles) shall be the standard for applications constrained by low bandwidth channels (typically less than 1 Mb/s that may not be adequately supported by MPEG-2). See Motion Imagery System Recommended Practice 9720 for guidelines. The MISB also allows the use of H.264 for higher bandwidth applications.

> 9701 Note 1: See Motion Imagery System Recommended Practice 9902 for guidelines concerning other digital motion imagery compression formats (such as DV).

(ISMC, 6 March 1998- Approved) (VWG, 21 January 1999 - Language Editorially Revised) (GSMC-ISMC, 12 August 1999 – Approved as Amended) (21 November-Revised) (12 June 2003 –MISB approved ITU-T Rec. H.264 for low bandwidth applications)

3.2.3 Xon2

"Xon2" is the name of a new DoD activity to support the "seamless" rollout of advanced video compression technologies without disrupting current and future operations and systems. "X" defines existing or future video compression technologies and "on2" refers to the use of MPEG-2 transport streams and files. The DoD has already successfully deployed "2on2" payloads, using standards compliant MPEG-2 compressed video elementary streams, audio elementary streams, and SMPTE KLV encoded metadata as MPEG-2 private data streams in support of unmanned aerial vehicle (UAV) operations. Building on this baseline "2on2" capability, "Xon2" will provide a migration path to inject improved compressions technologies, which will yield improved image quality and / or reduced bandwidths. NGA's Persistent Surveillance Office anticipates accelerating near term fielding of "Xon2" using advanced video compression technologies, such as H.264 ("264on2"). H.264 can be carried over the MPEG-2 transport

streams using *ITU-T Rec. H.222, Amendment 3, 2004: Transport of AVC data over ISO/IEC 13818-1/ H.222.0 for MPEG2 TS containment for MPEG4 AVC*.

(21 November 2002- MISB Adopted)

3.2.4 STANDARD 9702 – Standard Definition Digital Motion Imagery Sampling Structure

ITU-R BT.601-5 Component (4:2:2) Digital Video shall be the DoD/IC/NSGI STANDARD sampling structure for baseband (uncompressed) standard definition motion imagery signals.

Furthermore, while both 10 bit and 8 bit implementations are allowed under the standard, 10 bit implementations are preferred.

(VWG, 26 March 1997 - Adopted as Amended) (ISMC, 12 June 1997 - Approved)
(VWG, 25 February 1998 - Language Editorially Revised) (ISMC, 6 March 1998 - Approved)

3.2.5 STANDARD 9703 - Digital Motion Imagery, Uncompressed Baseband Signal Transport and Processing

SMPTE 259M (4:2:2) standard definition (270-360 Mb/s Serial Digital Interface - SDI) and SMPTE 292M high definition (1.5 Gb/s Bit-Serial Interface) shall be the uncompressed baseband signal transport and processing DoD/IC/NSGI STANDARDS for digital motion imagery, audio and metadata origination, system interface, production/analysis center processing and manipulation.

Furthermore, all DoD/IC/NSGI standard definition primary routing and distribution motion imagery hardware systems must comply with SMPTE 259M Levels C and D (270/360 Mb/s) implementations (270 /360 Mb/s data rates allow routing and distribution systems to pass both 4:3 and 16:9 aspect ratio digital motion imagery signals).

Furthermore, within SDI or bit-serial interfaces, one AES3 audio channel (one stereo pair) shall be reserved for mission audio (such as narration), one AES3 audio channel (one stereo pair) shall be reserved for mission metadata encoding.

Furthermore, as much as possible of ancillary data (separate from the AES3 requirements above) shall be reserved for metadata encoding.

Furthermore, bit-serial interfaces shall be the DoD/IC/NSGI STANDARD protocol for compression system input signals and decompression system outputs when further processing is required.

> 9703 Note 1: The “Connector Type” specification given in SMPTE 259M, Section 4, or 292M recommends a preferred connector (BNC) and cable type (coax). For DoD/IC/NSGI users, such physical connections and cable types can be considered to be Recommended Practices, not Standards. (Flexibility to use connectors other than BNC is given to accommodate operational directives, which do not allow BNC connectors in aircraft systems.)

(VWG, 26 March 1997 - Adopted as Amended) (ISMC, 12 June 1997 - Approved)
(VWG, 25 February 1998 - Language Editorially Revised) (GSMC-ISMC, 6 March 1998 - Approved) (VWG, 8 June 1999 – Language Editorially Revised) (GSMC-ISMC, 12 August 1999 – Approved as Amended) (20 November 2003 – MISB approved)

9703 Note 2: Further research is required (see STUDY 9806) to define the anticipated quality degradation of multiple "generation" (compression, decompression, compression...) concatenation effects.

(VWG, 26 March - Approved for Study)

3.2.6 STANDARD 9704 - Digital Motion Imagery, Compression Conversions

ITU-R BT.601-5 shall be the transitional sampling structure, compression conversion and processing DoD/IC/NSGI STANDARD for standard definition digital motion imagery, audio and metadata, where the input compressed motion imagery stream shall be uncompressed into ITU-R BT.601-5 Component (4:2:2) baseband video sampling structure (within bit-serial interface input/output signal processing equipment) and then shall be re-compressed into the target compression format.

9704 Note 1: For guidelines on use of multiple compression conversion cycles see Motion Imagery System Recommended Practice 9720.

9704 Note 2: The "Connector Type" specification given in SMPTE 259M, Section 4, recommends a preferred connector (BNC) and cable type (coax). For DoD/IC/NSGI users, such physical connections and cable types can be considered to be Recommended Practices, not Standards.

(VWG, 26 March 1997 - Adopted as Amended) (ISMC, 12 June 1997 - Approved)
(VWG, 25 February 1998 - Language Editorially Revised) (GSMC-ISMC, 6 March 1998 - Approved)

3.2.7 STANDARD 9705 – Standard Definition Digital Motion Imagery, Format Conversions

ITU-R BT.601-5 shall be the transitional sampling structure, format conversion and processing DoD/IC/NSGI STANDARD for standard definition digital motion imagery, audio and metadata, where the input video format is converted into ITU-R BT.601-5 Component (4:2:2) baseband video (within bit-serial interface input/output signal processing equipment) and is then re-formatted into target formats (such as 625 line component systems).

9705 Note 1: The "Connector Type" specification given in SMPTE 259M, Section 4, recommends a preferred connector (BNC) and cable type (coax). For DoD/IC/NSGI users, such physical connections and cable types can be considered to be Recommended Practices, not Standards.

9705 Note 2: This format conversion is intended to facilitate equipment interoperability between 525/30i (American) and 625/25i (NATO and Treaty Partner) motion imagery systems, where the SDI bit-serial interface has been designed for common digital motion imagery parameters wherever practical.

(VWG, 16 Jan 1997 - Adopted as Amended) (ISMC, 12 June 1997 - Approved)
(VWG, 25 February 1998 - Language Editorially Revised) (ISMC, 6 March 1998 - Approved)

3.2.8 STANDARD 9707 – Standard Definition Digital Motion Imagery Tape Recorder, Digital Motion Imagery Servers, and Similar Systems Input / Output Protocol

SMPTE 259M shall be the DoD/IC/NSGI STANDARD motion imagery input/output protocol for standard definition digital videotape recorder, digital motion imagery servers, and similar systems.

> 9707 Note 1: The "Connector Type" specification given in SMPTE 259M, Section 4, recommends a preferred connector (BNC) and cable type (coax). For DoD/IC/NSGI users, such physical connections and cable types can be considered to be Recommended Practices, not Standards.

Furthermore, "fiber channel" input/output protocols may be considered for digital motion imagery tape recorders, digital motion imagery servers, and similar systems provided such systems also have bit-serial interfaces available.

Furthermore, IEEE 1394 input/output protocols may be considered for digital motion imagery tape recorders, digital motion imagery servers, and similar systems provided such systems also have bit-serial interfaces available or that transparent conversion (from IEEE 1394 to bit-serial) interfaces are available.

> 9707 Note 2: IEEE 1394 defines a transport channel upon which multiple motion imagery (and other signal) sampling structures may be delivered. Systems that use the IEEE 1394 interface (such as "DV" format tape recorders) may not produce motion imagery sampling structures that meet the standards profiled in this MISP document. Users are cautioned to verify the video sampling structure delivered by any device that claims digital video delivery via IEEE 1394

(VWG, 26 March 1997 - Adopted as Amended) (ISMC, 12 June 1997 - Approved)
(VWG, 25 February 1998 - Language Editorially Revised) (ISMC, 6 March 1998 - Approved)

3.2.9 STANDARD 9803 - Serial Data Transport Interface

SMPTE 305.2M-2000, *Serial Data Transport Interface (SDTI),* shall define the DoD/IC/NSGI Standard for data stream used to transport packetized data within a studio/production center environment. The data packets and synchronizing signals are compatible with ANSI/SMPTE 259M.

(MISB, 7 February 2001 – SMPTE 305.2M-2000 Adopted; 01 March 2001 GSMC-ISMC Approved)

3.2.10 STANDARD 9901 – Fiber Optic Interfaces Uncompressed Baseband Signal Transport and Processing

SMPTE 297M shall be the fiber optic uncompressed standard definition (270-360 Mb/s Serial Digital Interface for baseband signal transport and processing DoD/IC/NSGI STANDARD for digital motion imagery, audio and metadata origination, system interface, production/analysis center processing and manipulation.

Furthermore, all DoD/IC/NSGI standard definition primary routing and distribution motion imagery hardware systems must comply with SMPTE 259M Levels C and D (270/360 Mb/s) implementations (270 /360 Mb/s data rates allow routing and distribution systems to pass both 4:3 and 16:9 aspect ratio digital motion imagery signals).

Furthermore, within SDI or bit-serial interfaces, one AES3 audio channel (one stereo pair) shall be reserved for mission audio (such as narration), one AES3 audio channel (one stereo pair) shall be reserved for mission metadata encoding.

Furthermore, at least 6 Mb/s of ancillary data (separate from the AES3 requirements above) shall be reserved for metadata encoding.

Furthermore, bit-serial interfaces shall be the DoD/IC/NSGI STANDARD protocol for compression system input signals and decompression system outputs when further processing is required.

(VWG, 26 March 1997 - Adopted as Amended) (ISMC, 12 June 1997 - Approved)
(VWG, 25 February 1998 - Language Editorially Revised) (ISMC, 6 March 1998 - Approved)

3.2.11 RECOMMENDED PRACTICE 9902 – Authorized Limited Applications of DV Format Video

Consumer cameras that capture digital motion imagery in near-professional quality using the Digital Video (DV) format are now available commercially and at low cost. In addition, the DV proprietary format is being transitioned from a proprietary standard to a published standard within SMPTE.

For "handheld" motion imagery applications the DV format promises a good tradeoff between image quality and system cost. Therefore, DV video format is authorized for specialized DoD/IC/NSGI applications requiring the use of consumer-grade palm-sized camcorders to meet limited, low profile (covert) mission requirements, provided that: 1) No less than 1st generation DV footage will be directly digitally transferred into computer processing systems using IEEE 1394 interfaces; 2) Such motion imagery DV clips will not be forwarded nor interfaced to any DoD/IC/NSGI communications nodes for subsequent processing.

Affordable devices are now commercially available to convert from the DV format to MISP approved digital formats for distribution and exploitation. (For example, a single chip is available that converts 25 Mbps DV to 6 Mbps MPEG-2.) Thus, DV-originated motion imagery that meets the above criteria may be distributed when it is converted to an approved digital format such as MPEG-2.

(VWG, 21 January 1999 – Adopted; VWG, 8 June 1999 – Language Revised) (VWG, 8 June 1999, Recommended to GSMC-ISMC for Approval) (GSMC-ISMC, 12 August 1999 – Approved)

3.2.12 STANDARD 9719 - Analog Video Migration

All DoD/IC/NSGI motion imagery production systems that currently use ANSI/SMPTE 170M analog video waveforms (also known as RS-170A) should convert to ITU-R BT.601-5 Component (4:2:2) digital sampling structure as soon as practical.

Furthermore, all new digital baseband motion imagery system production sampling structures shall conform to ITU-R BT.601-5 Component (4:2:2) sampling structures.

Furthermore, unique mission systems with legacy analog video waveforms should convert such analog video waveforms to ITU-R BT.601-5 Component (4:2:2) sampling structures as soon as possible in the signal processing chain, with no processing node backwards conversions to analog waveforms allowed.

(VWG, 26 March 1997 - Approved for Study) (VWG, 19 November 1997- Approved)

3.2.13 STANDARD 9709 - Use of Closed Captioning for Core Metadata Analog Video Encoding

EIA-608 (Data Services), commonly known as closed captioning, shall be the DoD/IC/NSGI STANDARD for legacy system analog video vertical interval metadata encoding using video line 21.

Note that any such analog video system data encoding is to be considered for legacy analog systems and may also be implemented by new systems for redundancy. New systems shall also conform to all applicable digital motion imagery, audio, and metadata protocols specified in the MISP.

MISP item 9711 shall be the basis for Geospatial metadata descriptions for DoD/IC/NSGI systems using Closed Captioning (until replaced by Motion Imagery Standards Profile item 9713).

MISP item 9714 shall be the basis for time references for analog video vertical interval data. Therefore, Motion Imagery Standards Profile item 9709 implementations should not be burdened with duplicate time reference data.

Furthermore, to facilitate universal inter-operability, DoD/IC/NSGI users are encouraged to submit recommended implementations for analog closed captioning systems for consideration and inclusion in this Motion Imagery Standards Profile document by the MISB as numbered Recommended Practices.

(VWG, 16 Jan 1997 - Adopted as Amended) (ISMC, 12 June 1997 - Approved)

3.3 Enhanced Definition Motion Imagery

3.3.1 STANDARD 9811 – Progressively Scanned Enhanced Definition Digital Motion Imagery

ITU-R BT.1358 shall define the DoD/IC/NSGI STANDARD motion imagery sampling structure for progressively scanned, digital enhanced definition motion imagery systems. Parallel connector interfaces shall not be used if bit-serial interfaces are

Furthermore, while both 10 bit and 8 bit implementations are allowed under the standard, 10 bit implementations are preferred.

(VWG, 25 February 1998 - Approved) (ISMC, 6 March 1998 - Approved)(MISB, 24 May 2001, BT.1358 replaces SMPTE 293M)(21 November 2002-Revised)

3.3.2 SMPTE 292M-1998, Television — Bit-Serial Digital Interface for High-Definition Television Systems

SMPTE 292M is the DoD/IC/NSGI STANDARD for Enhanced Definition digital motion imagery, audio and metadata bit serial interface for origination, system interface, production/analysis center processing and manipulation.

(21 November 2002- MISB Adopted)

3.3.3 STANDARD 0201 - Uncompressed Enhanced Motion Imagery Baseband Signal Transport

SMPTE 349M "Transport of Alternate Source Image Formats through SMPTE 292M" defines the uncompressed baseband signal transport of 525-line interlaced, 525-line progressive, 625-line interlaced, and 625-line progressive scan source formats through SMPTE 292M, the bit-serial digital interface for high-definition television systems.

(21 November 2002- MISB Adopted)

3.3.4 STANDARD 0202 – Compressed Enhanced Definition Advanced Television (ATV) and Associated Motion Imagery Systems

If compression is needed, ISO/IEC 13818 – 1 (Systems), 2 (Video) (commonly known as MPEG-2) "High Level", which defines a broad family of enhanced and high definition video compression capabilities, shall be the DoD/IC/NSGI STANDARD for compressed enhanced definition motion imagery, with the following PROFILE specification:

The MPEG-2, Main Profile @ High Level (MP @ HL) shall be the enhanced definition motion imagery compression PROFILE for DoD/IC/NSGI origination, acquisition, production, manipulation, exploitation, distribution and archiving.

ITU-T Rec. H.264 (Baseline, Main, and Extended Profiles) is also allowed for use on enhanced definition motion imagery. See RP 9720c for further guidance.

Note: "Xon2" is the name of a new DoD activity to support the "seamless" rollout of advanced video compression technologies without disrupting current and future operations and systems. "X" defines existing or future video compression technologies and "on2" refers to the use of MPEG-2 transport streams and files. The DoD has already successfully deployed "2on2" payloads, using standards compliant MPEG-2 compressed video elementary streams, audio elementary streams, and SMPTE KLV encoded metadata as MPEG-2 private data streams in support of unmanned aerial vehicle (UAV) operations. Building on this baseline "2on2" capability, "Xon2" will provide a migration path to inject improved compressions technologies, which will yield improved image quality and / or reduced bandwidths. NGA's Advanced Airborne Division anticipates accelerating near term fielding of "Xon2" using advanced video compression technologies, such as H.264 ("264on2"). H.264 can be carried over the MPEG-2 transport streams using *ITU-T Rec. H.222, Amendment 3, 2004: Transport of AVC data over ISO/IEC 13818-1/ H.222.0 for MPEG2 TS containment for MPEG4 AVC.*

(21 November 2002- MISB Adopted) (8 April 2004 – MISB approved)

3.4 High Definition Motion Imagery

3.4.1 STANDARD 9710 - High Definition Television Systems (HDTV)

SMPTE Standard 296M-2001 shall define the DoD/IC/NSGI STANDARD motion imagery sampling structure for progressively scanned digital high definition systems based on 720 vertical scanning lines. The standard incorporates multiple frame rates such as 24, 25 and 50 Hz. The parallel connector interface defined for SMPTE 296M-2001 shall not be used if bit-serial interfaces are available.

SMPTE 292M-1998 shall define the DoD/IC/NSGI STANDARD for bit-serial interfaces for high definition television systems, including by specific reference SMPTE 296M.

SMPTE 274M-1998 shall define the DoD/IC/NSGI STANDARD motion imagery sampling structures for progressively scanned digital high definition systems based on 1080 vertical scanning lines.

(VWG, 25 February 1998 - Approved) (ISMC, 6 March 1998 - Approved) (MISB, 27 July 2000 – Submitted)(02 November 2000 GSMC-ISMC Approved)(MISB, 7 February 2001- SMPTE 296M-2001 adopted; 01 March 2001 GSMC-ISMC Approved)

3.4.2 STANDARD 9723 – Compressed High Definition Advanced Television (ATV) and Associated Motion Imagery Systems

ISO/IEC 13818 – 1 (Systems), 2 (Video) (commonly known as MPEG-2) "High Level", which defines a broad family of high definition video compression capabilities, shall be the DoD/IC/NSGI STANDARD for compressed high definition advanced television and motion imagery, with the following PROFILE specifications:

> The MPEG-2, Main Profile (4:2:0) @ High Level (MP @ HL), shall be the high definition motion imagery compression PROFILE for DoD/IC/NSGI origination, acquisition, production, manipulation, exploitation, and end-user motion imagery product distribution, including real-time wide area transmissions.

Note "Xon2" is the name of a new DoD activity to support the "seamless" rollout of advanced video compression technologies without disrupting current and future operations and systems. "X" defines existing or future video compression technologies and "on2" refers to the use of MPEG-2 transport streams and files. The DoD has already successfully deployed "2on2" payloads, using standards compliant MPEG-2 compressed video elementary streams, audio elementary streams, and SMPTE KLV encoded metadata as MPEG-2 private data streams in support of unmanned aerial vehicle (UAV) operations. Building on this baseline "2on2" capability, "Xon2" will provide a migration path to inject improved compressions technologies, which will yield improved image quality and / or reduced bandwidths. NGA's Advanced Airborne Division anticipates accelerating near term fielding of "Xon2" using advanced video compression technologies, such as H.264 ("264on2"). H.264 can be carried over the MPEG-2 transport streams using *ITU-T Rec. H.222, Amendment 3, 2004: Transport of AVC data over ISO/IEC 13818-1/ H.222.0 for MPEG2 TS containment for MPEG4 AVC.*

(21 November 2002- MISB Adopted)

Furthermore, for digital terrestrial reception:

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By direction of the MISB and as ratified by the GSMC-ISMC, the following paragraph is temporarily removed (suspended) from mandated Standard status, pending further review by the MISB and the NCGIS. Significant concerns have arisen in the commercial television technology community with regards to the technical viability of the 8VSB RF Modulation standard specified in ATSC Doc. A/53. Therefore, it is prudent to suspend mandated implementation of this standard until further notice.

> (1) Within the United States, the DoD/IC/NSGI standard for receivers shall be in compliance with the Federal Communication Commission, "Fourth Report and Order," (24 December 1996) which adopted (except for Annex A, Section 5.1.2 Compression format constraints - including Table 3) ATSC Doc. A/53 as the United States Digital Television Standard.
>
> *(GSMC-ISMC, 12 August 1999 – Approved)*

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(2) Receivers for use in other world regions will need to consider terrestrial broadcast standards for that area. Furthermore, to promote universal interoperability, DoD/IC/NSGI high definition advanced television and motion imagery **RECEIVING** systems must be able to decode, process and display all of the diverse sampling structures and temporal rates within the MPEG-2 High Level profiles specified above, where the systems may either display the received signal in its native format or the signals may be re-formatted to the highest common progressive format supported by the system. The following specific motion imagery sampling formats and temporal rates are noted as a mandatory sub-set under the broader MPEG-2 High Level receiver umbrella:

> 1920 x 1080, frame rates 30p, 30p/1.001, 30i, 30i/1.001, 25p, 25i, 24p;
> 16:9 Aspect Ratios
>
> 1280 x 720, frame rates 60p, 60p/1.001, 50p, 30p, 30p/1.001, 25p, 24p;
> 16:9 Aspect Ratios
>
> 720 x 576, frame rates 50p, 25p, 25i, 24p;
> 16:9 or 4:3 Aspect Ratios
>
> 720 x 480 (483), frame rates 60p, 60p/1.001, 30p, 30p/1.001, 30i, 30i/1.001, 24p, 24p/1.001; 16:9 or 4:3 Aspect Ratios
>
> 640 x 480, frame rates 60p, 60p/1.001, 30p, 30p/1.001, 24p, 24p/1.001; 4:3 Aspect Ratios
>
> 9723 Note 1: For future enhancement and migration options, the following additional formats should be decoded by DoD/IC/NSGI MP@HL receiving systems, where the systems may either display the received signal in its native format or the signals may be re-formatted to the highest common progressive

format supported by the display (See SMPTE 274-1998):

1920 x 1080, frame rates 60p, 60p/1.001, 50p; 16:9 Aspect Ratios

Furthermore, DoD/IC/NSGI high definition advanced television and motion imagery **ORIGINATION, ACQUISITION, PRODUCTION, MANIPULATION**, and or **PROCESSING** systems must generate at least one of the following sampling formats and its associated temporal rates:

For High Definition applications:

1280 x 720, frame rates 60p, 50p, 30p, 25p, 24p; 16:9 Aspect Ratios

1920 x 1080, frame rates 30p, 25p, 24p; 16:9 Aspect Ratios

9723 Note 2: For future enhancement and migration options, 1080 progressive scan formats (50p/60p) are included as future objectives for high definition motion imagery applications, but the MISB notes that 1080 50p/60p systems are not yet commercially available. Therefore, 1080 50p/60p systems are not mandated under this VISP profile. The MISB will continue to periodically evaluate the availability of 1080 progressive scan format systems for future

9723 Note 3: Dual mode interlaced and progressive scan systems are authorized under this MISP profile, provided that for DoD/IC/NSGI applications, 1) only the progressive scan mode shall be used and 2) provided that the progressive scan mode is derived from a native progressive capture and is not derived from an interlaced image capture.

For Standard Definition applications:

720 x 576, frame rates 50p, 25p, 25i, 24p; 16:9 or 4:3 Aspect Ratios

720 x 480 (483), frame rates 60p, 30p, 30i, 30i/1.001, 24p;
16:9 or 4:3 Aspect Ratios

640 x 480, frame rates 60p, 50p, 30p, 25p, 24p; 4:3 Aspect Ratios

9723 Note 4: 720 horizontal pixels are the standard width for DoD/IC/NSGI standard and enhanced definition program origination and processing. DoD/IC/NSGI systems shall not originate or process imagery content using 704 horizontal pixels.

(VWG, 25 February 1998 - Approved As Amended) (ISMC, 6 March 1998 - Approved)

3.4.3 STANDARD 9703 - Digital Motion Imagery, Uncompressed Baseband Signal Transport and Processing

SMPTE 292M high definition (1.5 Gb/s Bit-Serial Interface) shall be the uncompressed baseband signal transport and processing DoD/IC/NSGI STANDARD for digital motion

imagery, audio and metadata origination, system interface, production/analysis center processing and manipulation.

9703 Note 1: The "Connector Type" specification given in SMPTE 259M, Section 4, or 292M recommends a preferred connector (BNC) and cable type (coax). For DoD/IC/NSGI users, such physical connections and cable types can be considered to be Recommended Practices, not Standards. (Flexibility to use connectors other than BNC is given to accommodate operational directives, which do not allow BNC connectors in aircraft systems.)

(VWG, 26 March 1997 - Adopted as Amended) (ISMC, 12 June 1997 - Approved) (VWG, 25 February 1998 - Language Editorially Revised) (GSMC-ISMC, 6 March 1998 - Approved) (VWG, 8 June 1999 – Language Editorially Revised) (GSMC-ISMC, 12 August 1999 – Approved as Amended)

3.5 Low Spatial/Temporal Motion Imagery

3.5.1 STANDARD 9706 - Motion Imagery Still Frames

The National Imagery Transmission Format (NITF 2.1) shall be the DoD/IC/NSGI STANDARD for digital still images that have been extracted from video image sequences. Once an image has been captured for individual still image processing, exploitation and dissemination; the image is no longer considered to be video and is therefore not subject to this Motion Imagery Standards Profile (but must meet all NITF

Furthermore, still images should be extracted from full resolution bit-serial interface video streams, with direct conversion and storage into NITF image formats (using no transitional analog processing steps).

Furthermore, still images may be directly extracted from MPEG-2 digital files provided there are no transitional analog processing steps.

(VWG, 16 Jan 1997 - Adopted as Amended) (ISMC, 12 June 1997 - Approved)
(VWG, 25 February 1998 - Language Editorially Revised) (GSMC-ISMC, 6 March 1998 – Approved As Amended)

3.6 Metadata

3.6.1 STANDARD 9708 - Imbedded Time Reference for Motion Imagery Systems

SMPTE 12M-1999, commonly known as SMPTE time code, shall be the DoD/IC/NSGI STANDARD for time annotation and imbedded time references for motion imagery systems.

Furthermore, within SMPTE 12M, Drop Frame Time Code shall be used for 60/1.001, 30/1.001, 24/1.001 frames per second (FPS) systems. Non-Drop Frame Time Code shall be used for 60, 50, 30, 25, and 24 FPS systems.

SMPTE 309M shall be the DoD/IC/NSGI STANDARD for precision time and date imbedding into SMPTE 12M time code data streams.

Furthermore, within SMPTE 309M, DoD/IC/NSGI users will use the Modified Julian Date (MJD) (Y2K compliant) date encoding format and Universal Coordinated Time (UTC) as the time zone format.

(VWG, 26 March 1997 - Adopted as Amended) (ISMC, 12 June 1997 - Approved)
(VWG, 25 February 1998 - Language Editorially Revised) (ISMC, 6 March 1998 - Approved)

3.6.2 STANDARD 9711 - Intelligence Motion Imagery Index, Geospatial Metadata

The VWG Metadata Sub-Group, "Core Video Metadata Profile," Version 1.0, 14 March 1997 is the DoD/IC/NSGI RECOMMENDED PRACTICE for analog video intelligence Geospatial Metadata. This RP for legacy analog video was developed to capture and transmit metadata over analog video services to take advantage of existing metadata previously only available in telemetry. The intention is that when analog motion imagery systems are replaced by digital systems that they will use the more extensible Metadata Dictionary and Encoding described by STANDARDS 9713, 9716-

(VWG, 26 March 1997 - Adopted) (ISMC, 12 June 1997 - Approved) (VWG, 8 June 1999 – Language Editorially Revised) (GSMC-ISMC, 12 August 1999 – Approved as Amended)

9711 Note 1: This Profile has been nominated by the MISB for candidate harmonization with the SMPTE " Metadata Dictionary" Standard

9711 Note 2: DoD/IC/NSGI users may begin system development activities using this Core Geospatial Metadata, with the understanding that metadata parameters may change depending on negotiations and coordination with SMPTE and commercial video equipment manufacturers. The expectation is that the Geospatial metadata forms the initial core of the DoD/IC/NSGI requirement set for the broader digital "Motion Imagery Metadata Dictionary" Standard, and once part of the broader standard, will provide significantly enhanced applicability and broad, universal interoperability with commercial index, archive, and Geospatial motion imagery systems. The new SMPTE standard should provide a single standard for both DoD/IC/NSGI and commercial systems.

(VWG, 16 January 1997 - Approved for Study)

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9711 Note 3: The Core Video Metadata Profile elements have been incorporated into the more extensive VWG "Metadata Dictionary and Encoding" Version 1.0 document.

However, it is expected that the analog Core Motion Imagery Metadata Profile will continue as long as legacy analog motion imagery systems are still fielded.

(VWG, 8 June 1999 – Language Editorially Revised)

3.6.3 STANDARD 9712 - Intelligence Motion Imagery Index, Content Description Metadata (Dynamic Metadata Dictionary Structure and Contents)

SMPTE 335M-2001, *Metadata Dictionary Structure*, SMPTE RP210.8-2004, *SMPTE Metadata Dictionary Contents,* and SMPTE EG37-2001, *Node Structure For the SMPTE Metadata Dictionary,* formerly known as the Intelligence Video Index (Video Metadata Dictionary), comprise the DoD/IC/NSGI STANDARD for the definition and identification of metadata elements encoded in digital motion imagery products.

All new DoD/IC/NSGI motion imagery systems that incorporate metadata shall use these standards for digital encoding of metadata into uncompressed digital motion imagery bit streams as a replacement for the closed captioning of metadata in analog legacy systems [9709]. These digital systems shall NOT encode metadata as digital closed caption information.

(VWG, 16 Jan. 1997 - Approved for Study; VWG, 19 November 1997- Language Revised) (VWG, 8 June 1999 – Language Revised) (VWG, 20 October 1999 - Adopted; Recommended to GSMC-ISMC for Approval) (24 February 2000 – GSMC-ISMC Approval) (MISB, 27 July 2000 – SMPTE Standard Recommended)(02 November 2000 GSMC-ISMC Approved)(MISB, 24 May 2001, Replaced 210.2 by 210.3)(20 November 2003 replaced 210.3 by 210.8)

3.6.4 STANDARD 9713 – Data Encoding Using Key-Length-Value

SMPTE 336M-2001, *Data Encoding Protocol Using Key-Length-Value,* is the DoD/IC/NSGI STANDARD protocol for encoding data essence and metadata (such as 9712) into Motion Imagery streams, files, and associated systems.

(VWG, 16 Jan. 1997 - Approved for Study; VWG, 19 November 1997- Language Revised) (VWG, 8 June 1999 – Language Revised) (VWG, 20 October 1999 - Adopted; Recommended to GSMC-ISMC for Approval) (24 February 2000 – GSMC-ISMC Approval) (MISB, 27 July 2000 – SMPTE Standard Recommended)(02 November 2000 GSMC-ISMC Approved)

3.6.5 STANDARD 9714 - Time Code Embedding

Digital Vertical Interval Time Code (D-VITC) shall be imbedded on digital video line 14 of all ITU-R BT.601-5 Component (4:2:2) and bit-serial interface systems. Users may implement LTC for internal processing (such as in tape recorders) provided D-VITC is always forwarded to the next processing element on digital video line 14.

Furthermore, SMPTE Ancillary Time Code (embedded in the bit-serial interface Ancillary data space) may be used instead of D-VITC, provided such time code data is part of other metadata delivered by the ancillary data stream.

Date and Time Zone information defined by SMPTE 309M shall be used to achieve Year 2000 (Y2K) compliance by all DoD/IC/NSGI systems.

(VWG, 26 March 1997 - Approved for Study; VWG, 19 November 1997- Language Revised;) (VWG, 8 June 1999 – Study Completed; Recommended to GSMC-ISMC for Approval) (GSMC-ISMC, 12 August 1999 – Approved)

3.6.6 STANDARD 9715 - Time Reference Synchronization

Universal coordinated time (UTC, also known as "Zulu"), clock signals shall be used as the universal time reference for DoD/IC/NSGI SMPTE 12M time code systems, allowing systems using time code to accurately depict the actual Zulu time of day of motion imagery acquisition / collection / operations.

Furthermore, when DoD/IC/NSGI "original video acquisition" motion imagery sequences are used as sources for editing onto new "edit master" sequences, the "edit master" sequence may have a new, continuous time code track. The time code for the new sequence should reflect the "document date" of the new motion imagery product.

Furthermore, Global Positioning System time, corrected to UTC, is the Recommended Practice for the source of time data.

(VWG, 19 November 1997, Adopted as Amended)
(VWG, 25 February 1998 - Language Revised) (ISMC, 6 March 1998 - Approved)

3.6.7 STANDARD 9716 – Packing KLV Packets into SMPTE 291 Ancillary Data Packets

SMPTE RP 214-2002, "Packing KLV Encoded Metadata and Data Essence into SMPTE 291M Ancillary Data Packets" is the DoD/IC/NSGI STANDARD for the encoding of metadata elements into Serial Digital Interface (SDI) SMPTE 291M ancillary data packets.

All new DoD/IC/NSGI motion imagery systems that incorporate metadata shall use these standards for digital encoding of metadata into uncompressed digital motion imagery bit streams as a replacement for the closed captioning of metadata in analog legacy systems [9709]. These digital systems shall NOT encode metadata as digital closed caption information.

(VWG, 26 March 1997 - Approved for Study, VWG, 19 November 1997- Language Revised) (VWG, 8 June 1999 – Language Revised) (VWG, 20 October 1999 - Adopted; Recommended to GSMC-ISMC for Approval) (24 February 2000 – GSMC-ISMC Approval)

3.6.8 RECOMMENDED PRACTICE 9717 - Packing KLV Packets into MPEG-2 Systems Streams

SMPTE RP 217-2001, *Nonsynchronized Mapping of KLV Packets into MPEG-2 System Streams,* is the DoD/IC/NSGI Recommend Practice for the non-synchronous encoding of metadata elements into MPEG-2 Systems Streams.

> Note: To be MISP compliant, KLV metadata in BOTH the Transport Stream and Program Stream must be identified by the registered format_identifier 0x4B4C5641 ("KLVA"). SMPTE RP 217-2001 states that 0x4B4C5641 is the format_identifier to be used for the Transport Stream, but 0x4B4C5641 or "some other descriptor" may be used for the Program Stream.

ISO/IEC 13818-1:2000/AMD 1: 2003: "Information technology -- Generic coding of moving pictures and associated audio information: Systems, AMENDMENT 1: Carriage of metadata over ISO/IEC 13818-1 streams" (DRAFT) is authorized for DoD/IC/NSGI use but is not mandated for the synchronous encoding of metadata for exchange of motion imagery and metadata files for collaboration of production work in progress

among analysts; storage of work in progress for access by multiple users; and permanent archive of all contributions to a finished work.

All new DoD/IC/NSGI motion imagery systems that incorporate metadata shall use these standards for digital encoding of metadata into compressed digital motion imagery bit streams (MPEG-2) as a replacement for the closed captioning of metadata in analog legacy systems [9709]. These digital systems shall NOT encode metadata as digital closed caption information.

(VWG, 26 March 1997 - Approved for Study, VWG, 19 November 1997- Language Revised) (VWG, 8 June 1999 – Language Revised) (VWG, 20 October 1999 - Adopted; Recommended to GSMC-ISMC for Approval) (24 February 2000 – GSMC-ISMC Approved) (MISB, 11 October 2001 – Submitted for Approval)(Revised 29 November 2001 for GSMC/ISMC approval)

3.6.9 STANDARD 9718 – Packing KLV Packets into AES3 Serial Digital Audio Streams

SMPTE 355M-2001 (previously SMPTE RP 213-2000), *Format for Non-PCM Audio and Data in AES3 – KLV Data Type,* is the DoD/IC/NSGI STANDARD for the encoding of metadata elements into AES3 data streams.

All new DoD/IC/NSGI motion imagery systems that incorporate metadata shall use these standards for digital encoding of metadata into AES3 audio bit streams as a replacement for the closed captioning of metadata in analog legacy systems [9709]. These digital systems shall NOT encode metadata as digital closed caption information.

(VWG, 26 March 1997 - Approved for Study, VWG, 19 November 1997- Language Revised) (VWG, 8 June 1999 – Language Revised) (VWG, 20 October 1999 - Adopted; Recommended to GSMC-ISMC for Approval) (24 February 2000 – GSMC-ISMC Approval) (MISB, 27 July 2000 – SMPTE RP Recommended) (02 November 2000 GSMC-ISMC Approved)

3.6.10 RECOMMENDED PRACTICE 0101 – Use of MPEG-2 System Streams in Digital Motion Imagery Systems

MISP RP 0101 shall be the recommended practice for use of MPEG-2 system streams in motion imagery systems.

(7 February 2001 - MISB Adopted; 01 March 2001 GSMC-ISMC Approved)

3.6.11 RECOMMENDED PRACTICE 0102.2 – Security Metadata Universal Set for Digital Motion Imagery

MISP RP 0102 shall be the recommended practice for use of security metadata in MPEG-2 digital motion imagery applications.

(7 February 2001 - MISB Adopted; 01 March 2001 GSMC-ISMC Approved) (20 November 2003 – MISB approved)

3.6.12 RECOMMENDED PRACTICE 0103 - Timing Reconciliation Universal Metadata Set for Digital Motion Imagery

This Recommended Practice (RP) defines a timing reconciliation metadata set to correct (reconcile) the original capture time of metadata with the User Defined Time Stamp stamped timecode usually associated with the capture time of the digital motion imagery or audio essence. Timing reconciliation metadata is not required if the application using

the metadata does not depend on the amount of timing error or uncertainty between the metadata capture and the video or audio essence capture.

(MISB, 24 May 2001 – Submitted for Approval)

3.6.13 Engineering Guideline 0104 - Basic Predator KLV Metadata

Engineering Guideline (EG) 0104.3 defines the basic and geospatially adjusted Predator UAV (Unmanned Aerial Vehicle) metadata to be encoded into a standard SMPTE KLV Metadata Universal Metadata Sets. This EG provides direction on the creation of a standard metadata sets for reliable exchange of Predator closed caption (CC) data among digital motion imagery systems.

The scope of this EG is strictly limited to metadata that originates as closed caption metadata in analog video from the Predator UAV. Analog video and closed caption metadata are legacy systems that may continue to be used during the transition to all-digital sensors and information infrastructures. This EG facilitates that transition only and does not constitute an approved end-system implementation.

(MISB, 24 May 2001 – Submitted for Approval) (20 November 2003 – MISB approved)(8 April 2004 – MISB approved)

3.6.14 STANDARD 0107 - Bit and Byte Order for Metadata in Motion Imagery Files and Streams

The MISB STANDARD 0107, "Bit and Byte Order for Metadata in Motion Imagery Files and Streams", 11 October 2001, defines the selection of big-endian for bit and Byte order (msb-first and MSB-first). This is applicable only to KLV metadata encoding. Bit and Byte order of essence is not affected.

(MISB, 11 October 2001 – Submitted for Approval by Metadata Working Group)

3.7 File Formats

3.7.1 RECOMMENDED PRACTICE 0106 – Advanced Authoring Format

Advanced Authoring Format (AAF), Advanced Authoring Format Object Specification, V 1.01, AAF Association, Jan. 2004, is recommended for DoD/IC/NSGI use but is not mandated for the exchange of motion imagery and metadata files for collaboration of production work in progress among analysts; storage of work in progress for access by multiple users; and permanent archive of all contributions to a finished work. The MISB anticipates mandating AAF in a future revision of the MISP. The MISB further recommends but does not mandate the AAF Profile ASPA 0.8 for Aerial Surveillance and Photogrammetry Applications.

(MISB, 24 May 2001 – Submitted for Approval) (21 November 2002- MISB Adopted) (12 June 2003-MISB approved changing from authorized to recommended) (20 November 2003 – MISB approved pending 30-day comments)

3.7.2 RECOMMENDED PRACTICE 0107 – Material Exchange Format

Material Exchange Format (MXF), SMPTE 377M, is recommended for DoD/IC/NSGI use but is not mandated for interchange of motion imagery for single programs, finished material between an archive and user and distribution of tailored sections of a finished work to satisfy a user's specific request.

(MISB, 24 May 2001 – Submitted for Approval) *(12 June 2003-MISB approved changing from authorized to recommended)*

4 INFRARED STANDARDS, INTEROPERABILITY PROFILES, RECOMMENDED PRACTICES AND ENGINEERING GUIDELINES FOR DoD/IC/NSGI IMPLEMENTATIONS

4.1 Infrared Motion Imagery Systems

Infrared (IR) motion imagery is defined as being in the spectral wavelengths from 1 to 14 um. Standards and Recommended Practices for IR are similar to those in the motion imagery standards levels (MISL) discussed in the previous section for the electro-optical or visible spectrum. This section enumerates the standards, recommended practices, interoperability profiles, and engineering guidelines specifically designed for IR. Collectively this range of standards shall also be referred herein as "infrared" or "IR". It is beneficial for IR to use motion imagery standards whenever possible to achieve the advantage of the higher volume, lower cost motion imagery product availability, utilize the same or similar modules for IR and EO motion imagery, and aid in fused products.

4.1.1 RECOMMENDED PRACTICE 0401 – Infrared Motion Imagery System Matrix

An Infrared (IR) Motion Imagery Systems Matrix" (IRSM) shall define a Recommended Practice for the simple identification of broad categories of IR Motion Imagery Systems. The intent of the IRSM is to give user communities an easy to use, common shorthand reference language to describe the fundamental technical capabilities of DoD/IC/NSGI IR motion imagery systems. The IRSM is similar to the MISM, but is listed in order of increasing resolution. The tables refer to progressive capture of IR imagery. Interlace is sometimes used in legacy systems but must be replaced at the end of useful life with progressive systems.

The IRSM (RP 0401) has six general bands:

0401a – Very Low Definition IR (IRSM-L1 – IRSM – L3)

0401b - Low Definition IR (IRSM-L4 and IRSM-L6)

0401c – Medium Definition IR (IRSM-L7 and IRSM-L9)

0401d - High Definition IR (IRSM-L10 – IRSM-L12)

0401e – Very High Definition IR (IRSM-L13 – IRSM-L15)

0401f – Super High Definition IR (IRSM-L16 –IRSM-L18)

Note that 0401f is a STUDY.

Table 3-1 depicts the general outline of the IRSM-L. The following Tables and their accompanying Technical Notes provide detailed technical specifications of the general performance of each IRSM-L level. Please note that the technical parameters of each major IRSM-L sub-division will be individually evaluated for adoption by the MISB.

RP	IRSM-L	Description
0401a	1	Very Low Definition IR – Distribution Compression
	2	Very Low Definition IR – Mild Compression
	3	Very Low Definition IR – No Compression
0401b	4	Low Definition IR - Distribution Compression
	5	Low Definition IR - Mild Compression
	6	Low Definition IR - No Compression
0401c	7	Medium Definition IR - Distribution Compression
	8	Medium Definition IR - Mild Compression
	9	Medium Definition IR - No Compression
0401d	10	High Definition IR - Distribution Compression
	11	High Definition IR - Mild Compression
	12	High Definition IR - No Compression
0401e	13	Very High Definition IR - Distribution Compression
	14	Very High Definition IR - Mild Compression
	15	Very High Definition IR - No Compression
0401f (Study)	16	Super High Definition IR - Distribution Compression
	17	Super High Definition IR - Mild Compression
	18	Super High Definition IR - No Compression

Table 3-1. Infrared Motion Imagery System Matrix-Level

4.1.2 RECOMMENDED PRACTICE 0401a – Infrared System Matrix, Very Low Definition IR

System Level	Common Description / Intended Application	System Attributes: Spatial Definition	System Attributes: Temporal Definition	System Attributes: Generation Resiliency	Applicable Standard (Note: Other Profiles, Practices may apply)	Nominal Horiz. Res.	Nominal Vert. Res.	Nominal Bit Depth	Frame Rates	Nominal Compression Ratio	Nominal Data Rate	Data Rate Range	Candidate Transport Channels (Nominal Rates)
IRSM-L3	Low Definition (LD) / Acquisition	Very Low	Standard	High	SMPTE 259M	160 - 180	120 - 144	8 - 14	25 – 60 FPS	Zero	10 Mb/s	4 Mb/s - 22 Mb/s	Partial T3, TCDL, ATM
IRSM-L2	LD / Processing / Archiving	Very Low	Standard	Medium	H.264 MP@L2	160 - 180	120 - 144	8	25 - 30 FPS	20:1	512 Kb/s	256 Kb/s – 1.5 Mb/s	Partial T1, TCDL, ATM
IRSM-L1	LD / Distribution	Very Low	Standard	Low	H.264 MP@L1.2	160 - 180	120 - 144	8	25 - 30 FPS	80:1	128 Kb/s	64- 384 Kb/s	Partial T1, Wireless

Table 3-2. Very Low Definition Infrared Motion Imagery (Recommended Practice 0401a)

(26August 2004 - MISB Adopted)

4.1.3 RECOMMENDED PRACTICE 0401b – Infrared System Matrix, Low Definition IR

System Level	Common Description / Intended Application	System Attributes: Spatial Definition	System Attributes: Temporal Definition	System Attributes: Generation Resiliency	Applicable Standard (Note: Other Profiles, Practices may apply)	Nominal Horiz. Res.	Nominal Vert. Res.	Nominal Bit Depth	Frame Rates	Nominal Compression Ratio	Nominal Data Rate	Data Rate Range	Candidate Transport Channels (Nominal Rates)
IRSM-L6	Low Definition (LD) / Acquisition	Low	Standard	High	SMPTE 259M	320 - 360	240 - 288	8 – 14	25 – 60 FPS	Zero	44 Mb/s	15 Mb/s - 90 Mb/s	T3, TCDL, ATM
IRSM-L5	LD / Processing / Archiving	Low	Standard	Medium	H.264 MP@L2.2 H.264 HP4@L2.2	320 - 360	240 - 288	8 8 – 12	25 - 30 FPS	20:1	2.5 Mb/s	1 – 4 Mb/s	2xT1, TCDL, ATM
IRSM-L4	LD / Distribution	Low	Standard	Low	H.264MP@L1.3 H.264 HP4@L1.3	320 - 360	240 - 288	8 8 – 12	25 - 30 FPS	80:1	512 Kb/s	256 - 768 Kb/s	Partial T1, Wireless

Table 3-3. Low Definition Infrared Motion Imagery (Recommended Practice 0401b)

(26August 2004 - MISB Adopted)

4.1.4 RECOMMENDED PRACTICE 0401c – Infrared System Matrix, Medium Definition IR

System Level	Common Description / Intended Application	System Attributes: Spatial Definition	System Attributes: Temporal Definition	System Attributes: Generation Resiliency	Applicable Standard (Note: Other Profiles, Practices may apply)	Nominal Horiz. Res.	Nominal Vert. Res.	Nominal Bit Depth	Frame Rates	Nominal Compression Ratio	Nominal Data Rate	Data Rate Range	Candidate Transport Channels (Nominal Rates)
IRSM-L9	Medium Definition (MD) / Acquisition	Medium	Standard	High	SMPTE 259M	640 - 720	480 – 576	8 - 14	25 – 60 FPS	Zero	200 Mb/s	62 Mb/s - 360 Mb/s	SDI, OC-12
IRSM-L8	MD / Processing / Archiving	Medium	Standard	Medium	MPEG-2 MP@ML	640 - 720	480 – 576	8	25 - 60 FPS	10:1	22 Mb/s	6 – 36 Mb/s	Half to Full T3, TCDL, ATM
					H.264 HP4@L3.2 H.264 MP@L3.2	640 - 720	480 – 576	8 – 12 8	25 - 60 FPS	20:1	11 Mb/s	3 – 18 Mb/s	Half T3, TCDL, ATM
IRSM-L7	MD / Distribution	Medium	Standard	Low	MPEG-2 MP@ML	640 - 720	480 – 576	8	25 – 60 FPS	45:1	4.5 Mb/s	1.5- 8 Mb/s	GBS, T2, ATM, DVD
					H.264 HP4@L3 (L3.1 > 30 FPS) H.264 MP@L3 (L3.1 > 30 FPS)	640 - 720	480 – 576	8 – 12 8	25 - 60 FPS	80:1	2.5 Mb/s	768 Kb/s - 4 Mb/s	GBS, 2xT1, ATM, DVD

Table 3-4. Medium Definition Infrared Motion Imagery (Recommended Practice 0401c)

(26August 2004 - MISB Adopted)

4.1.5 RECOMMENDED PRACTICE 0401d – Infrared System Matrix, High Definition IR

System Level	Common Description / Intended Application	System Attributes: Spatial Definition	System Attributes: Temporal Definition	System Attributes: Generation Resiliency	Applicable Standard (Note: Other Profiles, Practices may apply)	Nominal Horiz. Res.	Nominal Vert. Res.	Nominal Bit Depth	Frame Rates	Nominal Compression Ratio	Nominal Data Rate	Data Rate Range	Candidate Transport Channels (Nominal Rates)
IRSM-L12	High Definition (HD) / Acquisition	High	Standard	High	SMPTE 292M	1024 - 1280	720 - 1024	8 - 14	25 – 60 FPS	Zero	330 Mb/s	150 Mb/s – 1,100 Mb/s	HD-SDI, OC-12, OC-48
IRSM-L11	HD / Processing / Archiving	High	Standard	Medium	MPEG-2 MP@ML, MP@HL (>30FPS)	1024 - 1280	720 - 1024	8	25 - 60 FPS	10:1	33 Mb/s	15 – 110 Mb/s	T3, TCDL, ATM
					H.264 HP4@L4.2 H.264 MP@L4.2	1024 - 1280	720 - 1024	8 – 12 8	25 - 60 FPS	20:1	17 Mb/s	7.5 – 50 Mb/s	Partial T3, TCDL, ATM
IRSM-L10	HD / Distribution	High	Standard	Low	MPEG-2 MP@ML, MP@HL (>30 FPS)	1024 - 1280	720 - 1024	8	25 – 60 FPS	45:1	7 Mb/s	3.5- 24 Mb/s	GBS, T2, ATM, DVD
					H.264HP4@L3.2 H.264MP@L3.2	1024 - 1280	720 - 1024	8 -12 8	25 - 60 FPS	80:1	4 Mb/s	2 - 14 Mb/s	GBS, T2, ATM, DVD

Table 3-5. High Definition Infrared Motion Imagery (Recommended Practice 0401d)

(26August 2004 - MISB Adopted)

4.1.6 RECOMMENDED PRACTICE 0401e – Infrared System Matrix, Very High Definition IR

System Level	Common Description / Intended Application	System Attributes: Spatial Definition	System Attributes: Temporal Definition	System Attributes: Generation Resiliency	Applicable Standard (Note: Other Profiles, Practices may apply)	Nominal Horiz. Res.	Nominal Vert. Res.	Nominal Bit Depth	Frame Rates	Nominal Compression Ratio	Nominal Data Rate	Data Rate Range	Candidate Transport Channels (Nominal Rates)
IRSM-L15	Very High Definition (VHD) / Acquisition	Very High	Standard	High	SMPTE 292M	1920	1080	8 - 14	25 – 60 FPS	Zero	1,250 Mb/s	415 Mb/s – 1,750 Mb/s	OC-48
IRSM-L14	VHD / Processing / Archiving	Very High	Standard	Medium	MPEG-2 MP@ML	1920	1080	8	25 - 60 FPS	10:1	125 Mb/s	44 – 175 Mb/s	T3, CDL, ATM
					H.264 HP4@L4.2	1920	1080	8 - 12	25 - 60 FPS	25:1	50 Mb/s	22 – 50 Mb/s	T3, CDL, ATM
IRSM-L13	VHD / Distribution	Very High	Standard	Low	MPEG-2 MP@ML	1920	1080	8	25 – 60 FPS	45:1	28 Mb/s	10 - 44 Mb/s	GBS, T3, ATM, DVD
					H.264 HP4@L4.2	1920	1080	8 - 12	25 - 60 FPS	80:1	16 Mb/s	5 - 22 Mb/s	GBS, Partial T3,

Table 3-6. Very High Definition Infrared Motion Imagery (Recommended Practice 0401e)

(26August 2004 - MISB Adopted)

4.1.7 STUDY 0401f – Infrared System Matrix, Super High Definition IR

System Level	Common Description / Intended Application	System Attributes: Spatial Definition	System Attributes: Temporal Definition	System Attributes: Generation Resiliency	Applicable Standard (Note: Other Profiles, Practices may apply)	Nominal Horiz. Res.	Nominal Vert. Res.	Nominal Bit Depth	Frame Rates	Nominal Compression Ratio	Nominal Data Rate	Data Rate Range	Candidate Transport Channels (Nominal Rates)
IRSM-L18	Super High Definition (SHD) / Acquisition	Super High	Standard	High	SMPTE 292M SMPTE 372M-2002	2048 - 3840	2048 - 2160	8 - 14	25 – 60 FPS	Zero	2,000 Mb/s	840 Mb/s – 3,600 Mb/s	OC-48
IRSM-L17	SHD / Processing / Archiving	Super High	Standard	Medium	H.264 HP4@L5.1	2048 - 3840	2048 - 2160	8 - 12	25 - 60 FPS	20:1	100 Mb/s	44 – 180 Mb/s	T3, CDL, ATM
IRSM-L16	SHD / Distribution	Super High	Standard	Low	H.264 HP4@L5.1	2048 - 3840	2048 - 2160	8 - 12	25 - 60 FPS	80:1	25 Mb/s	10.5 - 44 Mb/s	TCDL, T3, ATM

Table 3-7. Super High Definition Infrared Motion Imagery (STUDY 0401f)

(26August 2004 - MISB Adopted)

4.1.8 RECOMMENDED PRACTICE 0402 – Infrared Image Capture

The DoD/IC/NSGI STANDARD IR sampling structure for progressively scanned, infrared motion imagery systems is found in RP 0402. The resolution classes of IR are 160x120, 320x240, 640x480 (including 640x512, 720x480, 720x512 and 720x576), 1024x720 (including 1280x720 and 1024x1024), 1920x1080, and 2048x2048 progressively scanned. Interlaced scanning IR systems are to be treated as legacy systems and shall be replaced with progressive systems at the end of their service lives. Furthermore, while 8-, 10-, 12- and 14-bit implementations are allowed under the standard, at least 12 bits are preferred. For Infrared motion imagery, frame rates of 25, 30, 50, and 60 are preferred, but lower and higher frame rates are allowed and tolerance should be in the system to allow 1/1.001 of 30 Hz and 1/1.001 of 60

(26August 2004 - MISB Adopted)

4.1.9 STANDARD 0402 - Parallel Interface for Infrared Motion Imagery

The MISB STANDARD 0402, also called the B-Kit Interface Control Document defines a parallel interface for Infrared systems with frame sizes less than or equal to those found in RP 0401c.

(26August 2004 - MISB Adopted)

4.1.10 STANDARD 0403 — Bit-Serial Digital Interface for Infrared Motion Imagery

SMPTE 292M high definition (1.5 Gb/s Bit-Serial Interface, HD-SDI) shall be the uncompressed baseband signal transport and processing DoD/IC/NSGI STANDARD for digital IR with frame sizes equal to or larger than those found in RP 0401c for all imagery, audio and metadata origination, system interface, production/analysis center processing and manipulation.

The MISB STANDARD 0403 defines the mapping for the different IR systems.

(26August 2004 - MISB Adopted)

4.1.11 STANDARD 0404 – Compression for Infrared Motion Imagery

If compression is needed, ISO/IEC 13818 –1 (Systems), and -2 (Video) (commonly known as MPEG-2) shall be a DoD/IC/NSGI STANDARD for compressed infrared motion imagery, with the following PROFILE specification:

The MPEG-2, Main Profile @ Main Level (MP @ ML) shall be the compression PROFILE for infrared motion imagery 720x480/30Hz and 720x576/25Hz for DoD/IC/NSGI origination, acquisition, production, manipulation, exploitation, distribution and archiving. The MPEG-2, Main Profile @ High Level (MP @ HL) shall be the compression PROFILE for infrared motion imagery 1280x720/60Hz for DoD/IC/NSGI origination, acquisition, production, manipulation, exploitation, distribution and archiving.

ITU-T Rec. H.264 is also allowed for use on infrared motion imagery. Consideration should be given to the Fidelity-Range Extension Profile, which allows 12- bit depth magnitude

and monochrome operation. See RP 0403 – Mapping of 14-bit Linear IR to 12-bit log for further guidance.

Note: "Xon2" is the name of the DoD activity to support the "seamless" rollout of advanced video compression technologies without disrupting current and future operations and systems. "X" defines existing or future video compression technologies and "on2" refers to the use of MPEG-2 transport streams and files. The DoD has already successfully deployed "2on2" payloads, using standards compliant MPEG-2 compressed video elementary streams, audio elementary streams, and SMPTE KLV encoded metadata as MPEG-2 private data streams in support of unmanned aerial vehicle (UAV) operations. Building on this baseline "2on2" capability, "Xon2" will provide a migration path to inject improved compressions technologies, which will yield improved image quality and / or reduced bandwidths. NGA's Advanced Airborne Division anticipates accelerating near term fielding of "Xon2" using advanced video compression technologies, such as H.264 ("264on2"). H.264 can be carried over the MPEG-2 transport streams using *ITU-T Rec. H.222, Amendment 3, 2004: Transport of AVC data over ISO/IEC 13818-1/ H.222.0 for MPEG2 TS containment for MPEG4 AVC.*

(26August 2004 - MISB Adopted)

4.1.12 STANDARD 0405 – Metadata for IR

The MISB STANDARD 0405 defines additional metadata required for infrared systems and how the metadata is transported consistent with Section 2.5 of the MISP.

(26August 2004 - MISB Adopted)

APPENDIX A – EMERGING STANDARDS, INTEROPERABILITY PROFILES, RECOMMENDED PRACTICES, AND ENGINEERING GUIDELINES FOR DoD/IC/NSGI IMPLEMENTATIONS

Note: MISP Studies that have been completed and approved as standards, recommended practices, or engineering guidelines are moved to Section 2.0.

STUDY 9801 – MPEG-4

Evaluate and/or support development of the emerging ISO/IEC 14496 (commonly known as MPEG-4) compression format standard for DoD/IC/NSGI systems for finished product dissemination applications. The MISB discourages the use of MPEG-4, Part 2 because it has been superseded by better compression systems, MPEG-4, Part 10, which is identical to H.264.

(VWG, 19 Nov 1997 - Approved for Study) (21 November 2002 – Approved by MISB)

STUDY 9802 – MPEG-7

Evaluate and/or support development of the emerging MPEG-7 standard for DoD/IC/NSGI applications.

(VWG, 19 Nov 1997 - Approved for Study)

STUDY 9803 – Serial Data Transport Interface

Evaluate the emerging Serial Data Transport Interface (SDTI) standard for DoD/IC/NSGI applications.

(VWG, 19 Nov 1997 - Approved for Study; VWG, 8 June 1999 – Language Revised) (MISB, 7 February 2001 – SMPTE 305.2M-2000 Accepted; Moved to Section 2.0)

STUDY 9804 – Colorimetry

Evaluate existing and/or support development of emerging standards for motion imagery colorimetry for DoD/IC/NSGI applications.

(VWG, 19 Nov 1997 - Approved for Study)

STUDY 9805 – Standard Motion Imagery Test Materials

Evaluate existing and/or support emerging standards for motion imagery test materials, including standard definition and high definition sequences, for DoD/IC/NSGI applications.

(VWG, 19 Nov 1997 - Approved for Study)

STUDY 9806 – Motion Imagery Concatenation Image Quality Protection

Evaluate and/or support development of emerging standards for systems that reduce or eliminate motion imagery encoding concatenation errors for DoD/IC/NSGI applications.

Three draft SMPTE standards relevant to this Study are in technical review by SMPTE Technical Committee N26, File Management and Networking Technology: "The MPEG-2 Re-Coding Data Set", "Transporting MPEG-2 Re-

Coding Information through 4:2:2 Component Digital Interfaces", "Transporting MPEG-2 Re-Coding Information through High-Definition Digital Interfaces". COTS implementations of these draft standards are already available.

Once SMPTE adopts the family of MPEG-2 re-coding standards and they have been evaluated by the MISB as meeting DoD/IC/NSGI requirements, the SMPTE MPEG-2 re-coding Standards will become a DoD/IC/NSGI STANDARD for the transfer of re-coded MPEG-2 digital waveforms for motion imagery systems.

(VWG, 19 Nov 1997 - Approved for Study; VWG, 8 June 1999 – Language Revised)

STUDY 9807 – Motion Imagery Quality Metrics

Evaluate and/or support development of emerging standards for systems based on "Just Noticeable Difference" (JND) techniques for automatic motion imagery image quality measurements, for DoD/IC/NSGI applications.

(VWG, 19 Nov 1997 - Approved for Study)

STUDY 9808 – Still Imagery Derived from Video Motion Imagery

Evaluate and/or support development of emerging standards such as NITF 2.1, NSIF, and or BIIF, for the carriage of still imagery derived from motion imagery and for the future carriage of native motion imagery segments and related metadata.

Note: Under this Study NGA has developed the capability to directly capture still images from MPEG-2 streams and output them in TIFF or NITF formats on the Windows NT platform. This prototype GFE software is available for use by Government agencies from the NGA Persistent Surveillance Office. COTS versions of this software are also available. These software products significantly preserve image quality as compared to traditional MPEG-2 decompression to base band video and subsequent frame grabs and storage to NITF file formats.

(VWG, 19 Nov 1997 - Approved for Study; VWG, 8 June 1999 – Language Revised)

STUDY 9809 – Audio Interchange

Evaluate audio standards for DoD/IC/NSGI applications. Initial study activities will include standards such as AES-3, MPEG-2 Audio, Dolby AC3.

(VWG, 19 Nov 1997 - Approved for Study)

STUDY 9810 – Low Bit-Rate Motion Imagery

Evaluate low bit-rate motion imagery for DoD/IC/NSGI applications.

(VWG, 19 Nov 1997 - Approved for Study)

STUDY 9903 - MPEG-2 Embedded Subheader

Develop concept and detailed technical implementation to embed the information content of the NITF header / subheader at a defined location in an MPEG-2 Program Stream (PS). This study includes preparation of format specifications for this information. The resulting program stream must be fully interoperable with commercial off-the-shelf MPEG-2 decoders and viewers.

(VWG, 8 June 1999 - Approved for Study)

STUDY 9904 - NITF Support for Motion Imagery

Develop RFC for addition of MPEG-1 and MPEG-2 (future growth: MPEG-4) support to the NITFS. This study includes preparation of format specifications. The resulting NITF files must be interoperable (with software modifications to process the motion imagery content) with existing systems that support NITF.

(VWG, 8 June 1999 - Approved for Study)

STUDY 0002 – MPEG and KLV Interoperability

Provide proper guidance as to which MPEG transport layer streams to use for different DoD/IC/NSGI motion imagery applications. Assure that KLV packs into the MPEG streams with global interoperability.

(MISB, 27 July 2000 - Approved for Study)

STUDY 0003 – Advanced High Definition Television

Motion Imagery System Matrix Level 14 (MISM-L14), Uncompressed Advanced High Definition Motion Imagery, should be refined to reflect technology in the laboratory. Examine compressed and uncompressed Advanced HD motion imagery taking into account multispectral sensor outputs.

Note 1: Only PROGRESSIVE SCAN formats are authorized for advanced high definition DoD/IC/NSGI motion imagery acquisition applications (systems used to originate, acquire, produce, process, manipulate, exploit, store, archive and disseminate motion imagery in support to imaging applications, including (but not limited to) Intelligence, Reconnaissance, and Surveillance).

(MISB, 27 July 2000 - Approved for Study)

STUDY 0004 - Motion Imagery Security, Authentication, and Encryption

Evaluate and/or support development of emerging standards in security/ releasability marking, digital signatures, digital watermarking, steganography, and encryption as applied to motion imagery and associated metadata for DoD/IC/NSGI applications.

(MISB, 27 July 2000 - Approved for Study)

STUDY 0105 – Motion Imagery Sensor/Collection Metadata

Enumerate digital metadata to be captured from sensors and vehicle subsystems on generic unmanned vehicles. Research available documentation from unmanned air vehicle (UAV), unmanned combat air vehicle (UCAV), unmanned ground vehicle (UGV), unmanned subsurface vehicle (UUV), and fixed-site surveillance sources. Focus of this study shall be on all metadata that directly supports the advanced collection, processing, exploitation, storage, retrieval, distribution, and use of motion imagery. Coordinate with ongoing UAV, UCAV, UGV, UUV, and fixed-site surveillance programs to compile a Recommended Practice describing a metadata schema to be embedded into digital motion

(MISB, 7 February 2001 - Approved for Study)(MISB, 24 May 2001, Changed Title)

STUDY 0106 – Advanced File Formats

Evaluate and/or support development of emerging standards for advanced digital media file formats for the exchange of motion imagery and metadata files across systems and applications.

(01 March 2001 GSMC-ISMC Approved for Study)

STUDY 0108 – Metadata for Scathe View

Evaluate and/or support development of emerging standards for Scathe View Metadata.

(11 October 2001 MISB Approved for Study)

STUDY 0109 - Precision Engagement Metadata

Evaluate and/or support development of emerging standards for Precision Engagement Metadata.

(11 October 2001 MISB Approved for Study)

STUDY 0201 - Motion Imagery Intelligence Annotation Standard and Transport

Assess and recommend graphic / text annotation standards (i.e. CGM, etc) for creation and management of static and dynamic graphic / text overlay annotations to be added to motion imagery intelligence products. Assess and recommend transport of annotation constructs within MISP standards (MPEG-2 TS w KLV PDS, KLV, X-on2, DoD AAF profile, etc.). Employ prototype tools to validate recommendations. Prepare draft MISP Standard / Recommended Practice for submission to IWG / MWG and MISB.

(21 November 2002- MISB Approved for Study)

STUDY 0202 – Transport of H.264 on MPEG-2

Study and assess ISO/IEC 13818-1:2000/FDAM 3: "Information technology -- Generic coding of moving pictures and associated audio: Systems, AMENDMENT 3: Transport of ISO/IEC 14496 part 10 video data over ISO/IEC 13818-1 streams" (DRAFT) for recommendation by the MISB.

(21 November 2002- MISB Approved for Study)

STUDY 0301 - DoD/IC/NSGI Profile of the SMPTE KLV Metadata Dictionary

Develop a Profile of the SMPTE Metadata Dictionary (335M and RP210) that is a subset focused on DoD/IC/NSGI applications and that further defines, clarifies and/or limits

material in the SMPTE 336M and RP210. Consider creation of new metadata elements unique to DoD/IC/NSGI applications, that comply with SMPTE 336M (KLV protocol), but will not appear in the SMPTE-published Dictionary. Also consider the establishment of a separate Groups (Sets, Packs, Labels) Dictionary for only DoD/IC/NSGI applications.

(12 June 2003 – MISB approved for study)

STUDY 0302 – 60.000/30.000 Frames Per Second Video

Evaluate acquisition of video imagery at true 60 and 30 Frames Per Second versus 59.94 and 29.97 for DoD/IC/NSGI applications. Investigate commercial product availability and examine operation with synchronous GPS/UTC time stamped metadata. Investigate conversion to 59.97 Hz for those that must display on standard definition receivers.

(20 November 2003- MISB Approved for Study)

STUDY 0303 – AAF – MXF Use Guidance

Evaluate AAF and MXF properties and features to provide guidance on the most appropriate use of each in DoD/IC/NSGI applications.

(20 November 2003- MISB Approved for Study)

STUDY 0304 – MPEG-2 Transport Stream Synchronous Metadata

Develop MISB RP or EG defining application of MPEG-2 systems Amendment 1 to synchronous KLV metadata transport in MPEG-2 private data streams.

(20 November 2003- MISB Approved for Study)

STUDY 0401 – Common Metadata Descriptor Documents

Investigate the current usage of the EG104.x as a **Predator** only document. The current definition of the metadata set(s) is based on the source of the data (i.e. Predator) and not the usage of the data (exploitation, general viewing, etc). Ideally the goal of all exploitation views the Motion Imagery independent of the platform – "its just video with KLV" not "Predator video with Predator KLV" or "Fire Scout video with Fire Scout KLV". The idea is to convert all forms of sensor metadata to common "exploitation" metadata set(s) based on the intended usage and processing.

Produce a document to be a "common" metadata description for more than one platform. All of the existing Predator specifications would be retained in the document as an appendix. Any new

platforms that use this EG would also be included as appendices in later versions of the document. Additionally the study should provide two other suggestions, primitive set and extended set. The "primitive" set is the least amount of information needed from small sensors (example: position and time). The "extended" set would contain larger amounts of information for more sophisticated processing e.g. geo-registration.

(8 April 2004 - MISB Approved for Study)

STUDY 0402 – Develop Infrared Motion Imagery Standards

Develop MISB standards, profiles of standards, recommended practices, and engineering guidelines pertaining to infrared motion imagery for inclusion in the MISP.

(26 August 2004 - MISB Approved for Study)

APPENDIX B - REFERENCES AND BIBLIOGRAPHY

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APPENDIX C – ACRONYMS AND ABBREVIATIONS

AES3 – Audio Engineering Society 3

ANSI – American National Standards Institute

ATM – Asynchronous Transfer Mode

ATSC – Advanced Television Systems Committee

ATV – Advanced Television

AVI – Audio / Video Interleaved

BIIF – Basic Image Interchange Format

BNC – British National Connector

CFR – Code of Federal Regulations

COTS - Commercial Off-the-Shelf

DoD – Department of Defense

DV – Digital Video

DVB – Digital Video Broadcasting

DVD – Digital Versatile Disk; Digital Video Disk

D-VHS – Digital VHS

D-VITC – Digital VITC

EBU – European Broadcast Union

ED – Enhanced Definition

EIA – Electronics Industries Association

ELT – Electronic Light Table

EO – Electro-optical

ETR – European Telecommunications Report

ETS – European Telecommunications Standard

FCC – Federal Communications Commission

FOV – Field of View

FPS – Frames Per Second

GFE – Government Furnished Equipment

GPS – Global Positioning System

GSMC – Geospatial Standards Management Committee

HD – High Definition

HDTV – High Definition Television

HL – High Level

IC – Intelligence Community

IEC – International Electrotechnical Commission

IEEE – Institute of Electrical and Electronics Engineers

IOC – Initial Operational Capability

IPL – Image Product Library

ISDN – Integrated Services Digital Network

ISMC – Imagery Standards Management Committee

ISO – International Organization for Standardization

ITU – International Telecommunication Union

ITU-R – International Telecommunication Union – Radiocommunications Sector

JND – Just Noticeable Difference

JTA – Joint Technical Architecture

KLV – Key-Length-Value

LTC – Longitudinal Time Code

MASINT – Measurement and Signature Intelligence

MIL-STD – Military Standard

MIPO – Motion Imagery Program Office

MISB – Motion Imagery Standards Board

MISM-L – Motion Imagery Systems Matrix -Level

MISM – Motion Imagery Systems Matrix

MISP – Motion Imagery Standards Profile

MJD – Modified Julian Date

ML – Main Level

MP – Main Profile

MPEG – Moving Picture Experts Group

MTI – Moving Target Indicator

NATO – North Atlantic Treaty Organization

NIIRS – National Imagery Interpretation Rating Scale

NSIF – NATO Secondary Imagery Format

NTA – NSGI Technical Architecture

NTSC – National Television Standards Committee

OC-3 – Fiber Optic Communications Standard (155 Mbps)

OC-12 - Fiber Optic Communications Standard (655 Mbps)

PAL – Phase Alternate Line Format

POTS – "Plain Old Telephone Service"

PS – Program Stream

QSIF – Quarter SIF (176x120 pixels)

RFC – Request for Change

RP – Recommended Practice

SAR – Segmentation and Re-assembly

SAR – Synthetic Aperture Radar

SD – Standard Definition

SDI – Serial Digital Interface

SDTI – Serial Data Transport Interface

SECAM – System Electronique Couleur Avec Mémoire

SIF – Standard Image Format (352x240 pixels)

SIGINT – Signals Intelligence

SMPTE – Society of Motion Picture and Television Engineers

STANAG – Standardization Agreement (NATO)

S-VHS – Super Vertical Helical Scan

T-1 – Telecommunications Link Standards (1.5 Mbps)

T-3 - Telecommunications Link Standards (45 Mbps)

TBD – To be Determined

TIFF – Tagged Image File Format

TS – Transport Stream

UAV – Unmanned Aerial Vehicle

NSGI – National System for Geospatial Intelligence

UTC – Coordinated Universal Time

UVID – Universal Video Index and Dictionary

VHS – Vertical Helical Scan

VISP – Video Imagery Standards Profile

VITC – Vertical Interval Time Code

VWG – Video Working Group

Y2K – Year 2000

APPENDIX D – REVISION RECORD

Date on Document	Version Number	Notes/Status
16 Jan 1997	0.96	Version 0.96 – First VWG VISP document under configuration control. 16 Jan 97 document plus 30-day provisional adoption items. Submitted to VWG and adopted with agreed changes on 26 Mar 97.
26 Mar 1997	0.97	Final baseline version as adopted by VWG (includes agreed changes from 26 Mar 97). Submitted to ISMC for approval. Approved by ISMC on 12 Jun 97 with agreed minor changes.
12 Jun 1997	1.00	Final ISMC approved baseline version (includes agreed minor changes from 12 Jun 97).
26 Sep 1997	1.10	Incorporates the following changes approved by the ISMC on 26 Sep 1997: V97-001 – Video Systems Matrix update - Section 4.0 – Recommended Practice 9720 V97-002 – Change of document title to: "Video Imagery Standards Profile" (Includes editorial changes and reorganization to align with other DoD/IC/NSGI standards documents)
19 Nov 1997	1.20	Incorporates the following changes approved by the VWG on 19 Nov 1997: V98-001 – Updates to and adoptions of Standard 9715 (Time Reference Synchronization), Updates to and adoptions of Standard 9723 (Advanced Television). Updates to and adoption of Video Systems Matrix RP 9720a (HD).
7 Jan 1998	1.21	Returns Standard 9723 (Advanced Television) to Emerging status and RP 9720a (HD) to Study status pending formal GSMC-ISMC approval; incorporates Explanatory/editorial changes. Note that 1.21 is the reference baseline for JTA 2.0
25 Feb 1998	1.22	Incorporates revisions to 1.2 (based on 60 days Comments Period); incorporates explanatory/editorial changes. Incorporates changes from 25 Feb VWG.
6 Mar 1998	1.3	GSMC-ISMC Approved As Amended.

REVISION RECORD (continued)

Date on Document	Version Number	Notes/Status
8 June 1999	1.4	Incorporates the following changes provisionally approved by the VWG on 20 Jan 1999 and with language revised by VWG on 8 June 1999: 1) Addition of a DoD/IC/NSGI Video Imagery Migration Objective section to Chapter 1. 2) Movement of 9714, Time Code Embedding, from Study to Standard status. 3) Temporary suspension of a portion of 9723 (FCC Fourth Report and Order). 4) Revision of Metadata Studies 9712, 9713, 9716, 9717, 9718 to reflect recent changes in draft SMPTE standards. 5) New Studies 9903, 9904, 9905 for NITF wrapper for motion imagery, MPEG-2 PS subheader, and Concise KLV Encoding. 6) Extensive revision of Recommended Practice 9720 to include addition of Enhanced Definition as a new VSM band with other VSM definitions changed accordingly. Note that the inclusion of this new definition required an extensive re-write of the VSM concept. Therefore, the new VSM scale will hereafter be annotated as VSM Revision 1 (VSM r1). 7) Movement of 9902 from Study to Recommended Practice 9902 status, authorizing limited applications of DV format video 8) Explanatory/editorial changes. a) Added Table of Contents b) Expanded References c) Added Glossary of Acronyms
12 Aug 1999	1.4	GSMC-ISMC Approved
20 October 1999	1.5	20 October meeting of VWG approved and recommended to GSMC-ISMC the movement of Metadata Studies 9712, 9713, 9716, 9717, 9718 to STANDARDS status; new Study 9906 on Segmentation and Re-assembly of KLV Packets; identification of relevant VWG documents for metadata standards; update to VISP version chronology; editorial changes.

Date on Document	Version Number	Notes/Status
24 February 2000	1.5	GSMC-ISMC Approved.
27 July 2000	1.6	Presented at the Motion Imagery Standards Board Meeting. Incorporates the following changes: 1) Editorial changes related to the change from VWG to MISB 2) Adoption of SMPTE Standards and Recommended Practices for Metadata Dictionary and KLV encoding protocol 3) Adoption of MISB Standard 001-720P to update to multiple frame rates including 24, 25 and 50 Hz
02 November 2000	1.6	GSMC-ISMC Approved.
7 February 2001	1.7	Approved by the Motion Imagery Standards Board. Incorporates the following changes: 1) Editorial changes in terminology from video to motion imagery 2) Acceptance of SMPTE 305.2M-2000, Serial Data Transport Interface; Movement of 9803 from Study status. 3) Acceptance of SMPTE 296M-2001, 1280 x 720 Progressive Image Sample Structure; Replaces the identical MISB Standard 0001-720P, which has been rescinded. 4) Acceptance, upon 30-day review, of RP – 0101, MPEG-2 System Streams 5) Acceptance, upon 30-day review, of RP – 0102, Security Metadata Universal Set; 6) Acceptance of four items for Study; 0103 - Timing Reconciliation; 0104 - Predator Engineering Guideline for Closed Captioning; 0105 - Unmanned Vehicle Metadata Sets; 0106 – Advanced File Formats *(direct request to GSMC/ISMC)* 7) Cancelled Study items 9905 and 9906
1 March 2001	1.7	GSMC-ISMC Approved.

Date on Document	Version Number	Notes/Status
24 May 2001	1.8	Submitted to the Motion Imagery Board for approval on 24 May 2001. Substantive changes are: 1. ITU-R BT.1358 replaces SMPTE 293M as the Enhanced Definition Standard 2. Adopts RP 0103 - Timing Reconciliation Universal Metadata Set for Digital Motion Imagery 3. Adopts Engineering Guideline 0104 - Basic Predator KLV Metadata 4. Adopts RP 0106 on Advanced Authoring Format 5. Adopts RP 0107 on Material Exchange Format 6. Updates to SMPTE RP210.3 metadata dictionary from RP210.2

11 October 2001	2.0	Submitted on 11 October 2001 to the Motion Imagery Board for provisional 30-day approval. Substantive changes are: 1. Editorially revised to be NATO friendly 2. ISO/IEC 13818-1, *Information technology - Generic coding of moving pictures and associated audio information*, Part 1: Systems, 2000 (also known as MPEG-2 Systems), includes amendments and replaces 13818-1, 1995 including Amendment 1: Registration Procedure for Copyright Identifier, Amend. 2: Registration of Private Data, and Draft Amendment 3: DSM-CC and Private Data. 3. ISO/IEC 13818-2, Information technology - Generic coding of moving pictures and associated audio information, Part 2: Video, 2000 (also known as MPEG-2 Video), includes amendments and replaces 13818-2, 1995 including Amendment 1: Registration Procedure for Copyright Identifier, Amendment 2: 4:2:2 Profile, Amendment 3: Multi-view Profile, and Draft Amendment 4: ITU-T Extension Code Assignment. 4. Adopt RP on Bit and Byte Order. 5. Adopt MPEG-2 Amendment for Synchronization of Metadata.

		6. Adopt the Revised Metadata RPs. 7. Adopt Study on Scathe View Metadata. 8.

21 March 2002	2.0a	Editorial Changes 1. Extended definition and Enhanced definition used interchangeably. Use Enhanced throughout the document 2. Change Joint to Coalition 3. Add 25 Hz progressively scanned to frame rate section 4. RP 9720c, d and e – Revise unexplained changes in text from previous version, e.g. 2.1.4.1.1 revised back to T3, ATM 5. Dates updated in References to same as text 6. Added to Acronyms and Abbreviations
21 November 2002	2.1	Submitted on 21 November 2002 to the Motion Imagery Board for provisional 60-day approval. Substantive changes are: 1. USIGS to NSGI 2. MPEG-2 MP@ML adopted 3. Xon2 4. SMPTE 349M-2001adopted for Enhanced Definition in SMPTE 292M 5. H.264 6. SMPTE 342M for HD-D5 7. SMPTE RP 214-2002 replaces MISB document 8. Removed two studies 9. Added two studies
12 June 2003	2.2	Approved by MISB. If no objection in 30 days from this date, 2.2 will be the approved MISP 1. New chairman 2. Standardized ITU-T Rec. H.264 for low bit rate applications 3. Recommended AAF and MXF 4. New Study

20 November 2003	2.3	Approved by MISB. If no objection in 30 days from this date, 2.3 will be the approved MISP. 1. Recommended the AAF Profile ASPA 0.7 for Aerial Surveillance and Photogrammetry Applications 2. Updated commercial standards references 3. Updated MISP RP 0102.1 to 0102.2 4. Updated MISP EG 0104.1 to 0104.2 5. Added 3 studies 6. Updated data rates for various motion imagery standards levels 7. Added guidance for the use of H.264 for low bit rate applications
8 April 2004	2.4	Approved by MISB. If no objection in 30 days from this date, MISP 2.4 will be the approved MISP. 1. Updated Infrared 2. Update AAF Profile ASPA 0.7 to 0.8 3. Allowed the use of H.264 for Standard Definition and Enhanced Definition Motion Imagery 4. Added data rates for H.264 5. Updated EG 0104.2 to 0104.3 6. Added one study 7. Updated references
26 August 2004	3.0	Approved by MISB. If no objection in 60 days from this date, MISP 3.0 will be the approved MISP. 1. Added Section 3 on Infrared Standards 2. Added Study on Infrared Standards 3. Modified recommended practice tables 4. Updated references 5. Modified line for imbedding Vertical Interval Time Code 6. Editorial changes